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17. Abstract

The report presents the design of a reduced-cost, adequately safe, minimum standard airport for remote communities. Its cost is approximately one-half that using conventional designs. It is designed to serve communities too small to warrant service by aircraft larger than light twins under day/night visual meteorological conditions. Features of the design include: a standard runway of 366 m length by 15 m width, seven alternative pavement sections, access road of one lane width, ATCO type trailer as a terminal building, extensive communication and visual landing aid facilities, plus a low-powered non-directional beacon.

The costs of providing such airports to remote communities, and the benefits from improved air access, in particular emergency evacuation, have been evaluated.

In the pilot province (Manitoba) there are twelve sites ranging in size from 90 to over 1000 population that would benefit from construction of new airports. In all the provinces there is an estimated total of 135 sites. Applying standardized costs, based on Winnipeg prices, the 135 airports would cost $153.3 million and produce incremental benefits of $295 million (present value over 20 years - 1985-$).

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17. Résumé Le rapport traite de l'étude d'un aérodrome répondant aux normes minimums, raisonnablement sûr, coûtant moins cher à construire et devant desservir les villages isolés du Canada. Il reviendrait environ deux fois moins cher qu'un aérodrome classique. On vise de la sorte à desservir les petites agglomérations dont la population est trop faible pour justifier un service par des avions autres que des bimoteurs légers, volant de jour ou de nuit dans des conditions météorologiques de vol à vue. L'aérodrome proposé a les caractéristiques suivantes: une piste de 366 m sur 15 m, une chaussée aéronautique construite d'après l'une des sept options proposées, une desserte routière à une voie, une remorque ATCO servant de bâtiment d'accueil permanent, des aides complètes à la navigation et à l'atterrissage à vue ainsi qu'une balise omnidirectionnelle de faible puissance.

Le rapport présente le coût estimatif pour la construction d'aérodromes du type proposé ainsi que les avantages d'une desserte aérienne améliorée, notamment les services d'évacuation d'urgence qu'elle autorise. Au Manitoba, qui est la région pilote pour la recherche, on dénombre 12 villages isolés dont la population varie de 90 à 1 000 âmes et dont le sort pourrait être grandement amélioré par l'implantation d'un aérodrome du type proposé. A l'échelle du Canada, on dénombre 135 villages isolés. Utilisant des coûts normalisés, en vigueur à Winnipeg, la construction de 135 aérodromes pour ces villages coûterait 153,3 millions, mais apporterait des avantages financiers supplémentaires de 295 millions de dollars de 1985, actualisés sur une base de 20 ans.

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SUMMARY

It is always prudent to search for means of reducing costs while improving services, especially when their provision is paid from public funds. This project's purpose is to improve year-round air access at reduced costs to Canada's remote communities lying within the provinces. At present, many small northern communities have float/ski plane service for about 44 weeks of each year and no air service for the balance. While float/ski planes currently offer service for 44 weeks in a year, due to the added weight and drag of floats/skis the aircraft so equipped are more costly to operate than are wheeled aircraft. Further, their payloads are reduced by the added tare weight of floats/skis. Reductions in aircraft Capital and O&M costs by year-round use of wheeled aircraft has been considered in this report.

This project develops a reduced-cost, adequately safe, minimum standard airport design for remote communities. Further, it estimates the financial implications of implementing a nation-wide program of construction of airports developed to the new guidelines. These remote airports can support normal and emergency air ambulance service utilizing aircraft operating at weights under 5,682 kg (12,500 lbs), in day/night visual meteorological conditions. The cost per airport using the new design is about one-half the typical cost of airports currently being built in the northern Manitoba region. For a 50% reduction in cost, the proposed airport design is restricted to a smaller, lighter class of aircraft than those operating at existing larger sites. These craft could provide normal and emergency air ambulance service to small remote communities.

The merits of constructing reduced-cost low-use airports are evaluated on the basis of assessing the benefits and costs of providing limited commercial and emergency air services to smaller communities than could normally be justified. Benefits counted include: improved health care and emergency air ambulance services; improved transportation access; increased earnings of air carriers and limited local employment. Costs include: emergency-use aircraft operating costs; airport capital and O&M costs. These are evaluated in the context of benefit:cost analysis.

The project is reported at three levels of detail with different emphasis on each report to suit the needs of three audiences:

(i) The Technical Memorandum Report provides considerable technical detail concerning: aircraft selections, airport design, community demographics, air travel demand, costs and benefits of the program. This report will be of interest to the technocrat.

(ii) The main report will primarily be of value to the program administrators and directors of health and transportation programs. It summarizes the major findings of the study. By necessity the material is condensed and for maximum comprehension requires careful reading.

(iii) The third level of detail is the Summary (this section). It is included in the main report as an overview of the scope of the program as applied to Canada. It will be of interest to those senior public

servants and politicians who are responsible for allocating funds between competing programs, such as health care delivery, education and transportation.

With the co-operation of the Manitoba government, the project examined the northern Manitoba area as being representative of those provincial areas possessing remote communities that could benefit from more air service. Much of the information is developed for this pilot region. The findings are subsequently extrapolated to the 10 provinces, as applicable.

In northern Manitoba there are 150 remote communities, twelve of which have a combined population of 4,200 persons, that meet the project's definition of a remote community, i.e. any permanent population grouping larger than 50 persons and not having year-round access to emergency service hospitals within a four hour round trip travel time by any combination of modes. Within the ten provinces there are an estimated 135 such remote communities without adequate service out of an estimated total remote communities of 1700. The 135 out of 1700 communities in the ten provinces may seem a relatively small number requiring this type of airport. This number is based on very strict Benefit:Cost Analysis. Many more sites would benefit and would be identified as qualifying under the less rigid justifications applied to larger communities. Further, in the North West Territories and the Yukon, not included in this study, there are likely many additional small communities that would qualify.

At present, the 12 Manitoba remote communities are served by air for approximately 44 weeks of the year by small aircraft operating off floats in summer and skis in winter. For eight weeks during spring break-up and fall freeze-up, there is no air service. During this time, there is no four- hour emergency air service available. For the balance of the year, the air service is not to the proposed level of service due to limitations of the aircraft equipment used and waterdromes available.

The demand for air transport in northern Manitoba is high. It is comprised of two types: emergency air ambulance and regular air transportation service. Some statistics on these two types are of interest.

Manitoba and Ontario experience suggests that about 2% of the population requires emergency air ambulance service each year. Applying this to a typical community of 400 persons, there would be eight emergency air trips per year. Forty-eight percent (3.84) of these eight patients would be in a life threatening condition and annually one-third or 1.28 persons will owe their lives to this service. While crediting the float/ski airplane service with ability to serve some of these cases, construction of a year-round airport is projected to save 0.74 lives per year and avoid 1.48 permanent disabilities. Further, prompt attention will reduce losses from non-permanent disabilities.

The above benefits can be summarized in monetary terms. They are the marginal or incremental benefits over those available from the present air service for the 400 person community. They are summarized below. For the 4200 persons these benefits are increased approximately 10-fold and for all the provinces about 11.25 times. Thus it is seen that the air emergency benefits from the proposed new design airports are sizeable. In addition, there are air user time savings.

	Annual Benefit	Present Value Benefit (20 years@ 10%)
Emergency Health Care:		
Lives Saved	$ 175,380	$1,497,960
Disabilities Prevented	68,080	581,490
Temporary Work Days Saved	320	2,750
Air Service User Time Saving	49,600	422,050
Total	$ 293,380	$2,504,250

Normal air travel is also important to these communities. Some informative statistics on this type of travel when applied to a 400-person community are:

- 3,140 passenger trips per year (80% business; 20% personal)
- 1,509 aircraft movements per year
- 197,500 kg of cargo delivered per year

Of concern is the safety of the smaller, lower-cost airports. During the period 1976 to 1984 (latest available statistics) there was one airport related aircraft accident in the under 5,682 kg category at sites with runways under 915 m in the northern Manitoba study area. Overall, scheduled air travel produces only 8% as many fatalities per passenger-km flown as does road travel. Flying is 12.5 times safer than road travel when experienced operators are involved. A lack of quantitative data prevented defining how many more accidents would occur due to use of the proposed new shorter 366 m long by 15 or 18 m wide runway. Analysis did show that the "design" aircraft can operate off such a length. A hypothetical analysis suggests the aircraft serving the 400 population community would experience a run-off to the side once each 2,600 years. The above suggests but does not prove the reduced design is adequately safe. Quantitative experimental data is required to finalize the dimensions.

Three different aircraft provided input into the airfield design: Cessna 185; DHC-6-300 Twin Otter; Citation II. While the DHC-6-300 was selected as representing the most appropriate type for the test region there are additional factors that could make the Citation II the better choice on a cost effectiveness basis. While the latter aircraft requires a longer and wider pavement than does the Twin Otter, it offers a higher level of service as an air ambulance, is faster, and can serve the entire region based at Winnipeg.

In Manitoba's case the Province already operates a Citation II as an air ambulance to its existing airports. It could be cost effective to enlarge the remote airport design slightly to accommodate this aircraft, thereby increasing the aircraft's annual utilization and lowering its hourly operating costs.

Two airfield designs were developed , one each for the DHC-6-300 and the Citation II. These were both developed for northern Manitoba site elevations and design temperatures (300 m ASL and 22° C).

Significant differences in runway design for the DHC-6, Citation II and typical design are summarized below:

	DHC-6	Citation II	Typical Northern Manitoba
Runway Length (m)	366	734	930
Runway Width (m)	15.2	18.0	23.0
Standardized Airfield Pvt. Costs for Gravel Surfaces	$266,800	$478,800	$712,100

In addition to reduced geometric dimensions, other features are incorporated in the low-cost remote airport design. The various components are mostly proven at various sites, but have not been combined into one overall design.

Major features are:

- Use of a prefabricated ATCO type trailer as a permanent air terminal building.
- Construction of the access road as a single lane, rather than two-lane road.
- Runways constructed using both full strength and reduced strength pavements, thereby lowering costs.
- Seven alternative pavement sections were evaluated. On a comparative basis their costs range from a low of $3 - 4 per square meter for gravel to a high of $71 for heavy duty aluminum plank. Each one may be the most cost effective at a given site. For example if gravel or crushed rock are not economically available but sand is, then a locally produced Portland or Asphaltic cement sand pavement should be considered.

A comparison of an airport's 20-yr (1985-$) costs for the proposed design versus the conventional (915 m runway) design follows;

	Conventional	Proposed	% Reduction
Civil Works	$893,000	$409,000	54
ATB	$219,000	$ 60,000	73
Ltg. & Nav. Aids	$150,000	$ 81,000	46
Mobile Eqpt.	$310,000	$310,000	0
Total	$1,572,000	$860,000	45

These costs are based on Winnipeg prices. The local components of construction would increase in cost by a factor of 2.0 to 2.5 to account for the site difficulties. On a 135 site nation-wide system, applying to the affected components, a cost factor of 2.0 increases the total costs by 40% and use of 2.5 increases the costs by 60%.

Considering all 135 sites as being eligible, the airport costs, including gravel surfaced pavements, are $153.3 million for airports, $5.4 million for increased aircraft accidents and $5.2 million for incremental increased aircraft operating costs due to year-round operations on wheels. (Aircraft on

floats or skis have higher operating costs than those on wheels but operate for 10 out of 12 months each year.) Offsetting these costs are projected incremental benefits of some $295 M - (1985-$).

Thus adoption of the plan would generate net benefits to the nation's economy of $131 M over 20 years.

On a quantifiable costs and benefits basis, and using Winnipeg prices, the break-even community size is 170 persons for an airport built to the suggested design for a DHC-6 design aircraft. The community size rises to 220 persons for break-even using the Citation II as the design aircraft. Thus 7 to 9 of the 12 sites would qualify.

Applying a location cost inflation factor of 2.0 over Winnipeg for northern construction, the break-even community size for the Twin Otter design increases to 260 (5 communities).

Taken over all of Canada there are an estimated 78 to 101 remote sites that are cost justified. In addition, there are non-quantifiable benefits, not included in the above analysis that if taken into consideration would decrease the break-even community size and increase the number of justified airports.

In conclusion, there are an estimated 135 remote communities within the provincial areas of Canada that could benefit from construction of airports using the proposed low-cost airport design. One of the major benefits is the bringing of fast emergency air ambulance service to communities otherwise too small to be served.

Prior to implementation of the design, additional research is required in the areas of: airport/aircraft accidents, minimum acceptable runway widths and lengths. Further, study is required on finalization of the design aircraft that is most cost effective for each province's situation. When an aircraft like the Citation II is already available for air ambulance work, extending its use to service these smaller sites may be more cost effective than using the DHC-6-300 type aircraft.

As for the Citation-type of aircraft, evaluation of twin-engine turbine powered helicopter service should be considered as an alternative to fixed-wing ambulance service, prior to any province's undertaking a new airport construction program.

SOMMAIRE

La prudence commande toujours de chercher le moyen de réduire le coût des services tout en améliorant ceux-ci, surtout lorsqu'ils sont financés par les deniers publics. La présente recherche avait pour objet l'amélioration de la desserte aérienne des villages isolés du Canada, sans égard aux saisons, et au meilleur coût. A l'heure actuelle, nombre de villages des régions septentrionales ont un service aérien assuré par avions sur flotteurs ou skis pendant quelque 44 semaines par an, seulement.

La recherche a porté sur l'étude d'un aérodrome répondant aux normes minimums, raisonnablement sûr et coûtant moins cher à construire, et sur le coût estimatif d'un programme pour l'implantation à l'échelle nationale d'aérodromes du type proposé. Ceux-ci pourront recevoir des avions d'une masse inférieure à 5 682 kg (12,500 lb) assurant la desserte normale et d'urgence des villages isolés et volant, de jour ou de nuit, dans des conditions météorologiques de vol à vue. La réalisation d'un aérodrome du type proposé revient à environ la moitié du coût d'un aérodrome du type couramment construit dans la partie septentrionale du Manitoba. Il recevra des avions forcément plus légers et plus petits, mais qui seront capables d'offrir les services normaux et d'urgence requis.

Trois types de comptes rendus ont été faits, se distinguant par le niveau de détail, par l'auditoire visé et par les aspects qu'ils mettent plus particulièrement en évidence.

i) L'annexe technique qui traite en profondeur les aspects suivants : choix du type d'avion, conception de l'aéroport, démographie, demande de transport aérien, rapport avantages-coût du programme; elle intéresse surtout les spécialistes.

ii) Le rapport principal dirigé surtout vers les gestionnaires des programmes de santé, de transport et d'autres. Il récapitule le résultat de la recherche et doit être lu très attentivement de manière à en saisir toutes les nuances.

iii) Le présent sommaire qui survole la recherche et traite de son application au Canada. Il s'adresse aux hauts fonctionnaires et aux politiciens chargés de répartir les fonds publics entre les programmes de santé, d'éducation et de transport.

Profitant de l'assistance apportée par le gouvernement du Manitoba, les chercheurs ont étudié la région septentrionale de cette province qu'ils ont considérée comme étant représentative de toutes celles qui comptent des villages isolés à qui une desserte aérienne accrue serait plus que bénéfique. Presque toute l'information contenue dans ce rapport concerne cette région pilote; elle a été extrapolée par la suite pour s'appliquer aux dix provinces, chaque fois que cela a été possible.

La région septentrionale du Manitoba compte 150 villages isolés, qui cadrent avec la définition de village isolé retenue, à savoir agglomération permanente comptant plus de 50 âmes et ne disposant pas de services hospitaliers d'urgence accessibles toute l'année durant à moins de quatre heures aller-retour, utilisant un ou plusieurs modes de transport. Parmi ces villages, les douze qui ont été retenus pour le projet pilote totalisent 4 200

âmes. Dans les dix provinces du Canada on estime à 135 le nombre de villages répondant à cette définition, sur un total de quelque 1 700.

A l'heure actuelle, les 12 villages manitobains recensés sont desservis pendant quelque 44 semaines par an par un service aérien utilisant de petits avions sur flotteurs en été, sur skis en hiver. Le reste de l'année, c'est-à-dire pendant le dégel printanier et le gel automnal, ces villages ne sont pas desservis par voie aérienne, de sorte qu'ils ne disposent d'aucun service ambulancier aérien de type direct. Et même durant les 44 semaines où un tel service est disponible, le niveau de service est inférieur au niveau proposé à cause du type d'avion utilisé et de la distance plus ou moins grande qui séparent ces villages des plans d'eau utilisables.

Or, la demande de transport aérien au Manitoba septentrional est forte. Elle se divise en transports aériens normaux et d'urgence. Voici ci-dessous quelques chiffres intéressants concernant ces deux types de transport aérien.

Les statistiques au Manitoba et en Ontario montrent que, chaque année, environ 2 p. 100 de la population, a besoin de services ambulanciers aériens d'urgence. Appliquant ce pourcentage à un village isolé de 400 personnes, on arrive à un chiffre de 8 personnes devant être secourues d'urgence par an. De celles-ci, 48 p. 100 (3,84 personnes) nécessiteront un service de première urgence, alors qu'un tiers (1,28 personne) devront leur vie à ce type de secours. Tout en reconnaissant qu'un service aérien utilisant des avions sur flotteurs ou skis peut être d'un grand secours à un certain nombre de ces huit cas, on a calculé que l'implantation d'un aérodrome du type proposé permettrait de sauver 0,74 vie par an et d'éviter 1,48 invalidité permanente. De plus, un secours rapide réduirait les pertes attribuables à des invalidités non permanentes.

Tous ces avantages peuvent être évalués en termes monétaires. Ils s'ajoutent à ceux qu'un village-type de 400 âmes tire actuellement du service aérien tel qu'il existe. Ils sont récapitulés dans le tableau ci-dessous. En extrapolant aux 4 200 personnes du projet pilote, les avantages se trouvent multiplés par 10 environ, et par 11,25 environ, pour toutes les provinces confondues. On constate donc que l'avantage apporté par un service aérien d'urgence accru, découlant du type d'aérodrome proposé, est considérable, sans compter les gains de temps profitant aux voyageurs aériens en temps normal.

	Avantages annuels	Avantages annuels actualisés : 20 ans à 10%
Services ambulanciers :		
vies sauvées	$ 175 380	$1 497 960
invalidités évitées	68 080	581 490
jours travaillés gagnés	320	2 750
Gains de temps pour les voyageurs aériens	49 600	422 050
Total	$ 293 380	$2 504 250

L'importance du service aérien normal ne doit pas non plus être négligée. Les statistiques concernant ce type de déplacements, appliquées à un village de 400 âmes, sont d'ailleurs éloquentes :

- 3 140 déplacements par an (80 % pour motif d'affaires et 20 % personels),

- 1 509 mouvements aériens par an,

- 197 500 kg de fret livrés par an.

L'aspect sécurité des petits aérodromes qui ne coûtent pas cher à construire est important. De 1976 à 1984 (dernière année dans la région pilote pour laquelle des statistiques sont disponibles) il y a eu un accident d'avion sur aérodrome, dans la catégorie appareils de masse inférieure à 5 682 kg et piste ayant moins de 915 m de longueur. Les statistiques montrent que, globalement, le nombre de décès par passager-km attribuables au transport aérien régulier n'est que de 8 p. 100 du total des décès attribuables au transport routier. Le transport aérien est donc 12,5 fois plus sûr que le transport routier, lorsqu'on a affaire à un transporteur expérimenté. On ne dispose pas de données suffisantes pour permettre de calculer l'augmentation possible du nombre d'accidents advenant la mise en service des aérodromes du type proposé, d'une longueur ramenée à 366 m et dont la piste aurait entre 15 et 18 m de largeur. Toutefois, l'analyse a montré que l'avion de référence peut fonctionner à partir d'une telle longueur de piste. Une analyse théorique débouche sur le résultat qu'il y aurait un cas de déportement par 2 600 ans. Ce résultat ne prouve pas que l'aérodrome du type proposé est raisonnablement sûr, mais au moins il le laisse entendre. Pour déterminer le dimensionnement définitif, des expérimentations seront nécessaires.

Trois avions de type différent, le Cessna 185, le DHC-6-300 (Twin Otter) et le Cessna Citation II, ont été envisagés à titre d'avion de référence. C'est le DHC-6-300 qui a été choisi comme étant le mieux adapté à la région pilote, mais certains facteurs pris en compte séparément tendent à montrer que le Citation II pourrait être un meilleur choix sur le plan du rapport avantages-coût. Bien que nécessitant une piste plus longue et plus large que le Twin Otter, le Citation II offre un niveau de service ambulancier plus élevé et, de plus, il est plus rapide et peut desservir toute la région pilote à partir de sa base à Winnipeg.

En ce qui concerne le Manitoba, un service ambulancier existe déjà, utilisant un Citation II. Il serait donc économique de donner à l'aérodrome proposé des dimensions légèrement plus grandes, de manière qu'il puisse recevoir cet appareil, augmentant de la sorte le taux d'utilisation annuel de celui-ci et abaissant son coût d'exploitation horaire.

Deux types de pistes ont été étudiées, l'une en fonction du DHC-6-300 et l'autre du Citation II, mais les deux en fonction de l'altitude des sites d'implantation dans la région pilote et des températures de référence, 300 m par rapport au niveau de la mer et 22°C, respectivement.

Les principales caractéristiques de ces deux pistes figurent au tableau ci-dessous, comparativement à celles de la piste de construction courante dans la région pilote.

	DHC-6	Citation II	Piste de construction courante
Longueur de piste (m)	366	734	930
Largeur de piste (m)	15,2	18.0	23.0
Coût normalisé de la chaussée en gravier	$266 800	$ 478 800	$ 712 100

Outre ses cotes réduites, l'aérodrome proposé se signale par des caractéristiques particulières bien confirmées par l'usage mais qui n'avaient jamais été réunies dans un même concept. Ce sont les suivantes :

- utilisation d'une remorque ATCO préfabriquée pour servir de bâtiment d'accueil permanent,

- construction d'une desserte routière à une voie et non pas deux,

- pistes construites ayant une partie renforcée pleine largeur et une partie renforcée à demi-largeur seulement, d'où un coût plus bas,

- sept options de chaussée ont été évaluées et comparées. Le coût varie entre 3 à 4 $ par m^2 pour la chaussée en gravier et 71 $ le m^2 pour une chaussée en aluminium résistant. Suivant le site d'implantation, l'une ou l'autre des sept options pourra dégager le meilleur rapport avantages-coûts. Par exemple, si le gravier ou la roche concassée est chère, mais non le sable, alors une chaussée de sable et de ciment portland ou de bitume produit localement serait la bonne solution.

Ci-dessous, un tableau comparatif du coût de l'aérodrome proposé sur 20 ans (en dollars de 1985), avec celui de l'aérodrome de construction courante (piste de 915 m) :

	courant	proposé	% en moins
Génie civil	$ 893 000	$409 000	54
Bâtiment d'accueil	$ 219 000	$ 60 000	73
Aides d'approche	$ 150 000	$ 81 000	46
Equipements	$ 310 000	$310 000	0
Total	$1 572 000	$860 000	45

Ce sont des prix courants à Winnipeg mais qui, localement, doivent être multipliés par un facteur de surcoût de 2 à 2-1/2 selon les endroits. Etendu au réseau national de 135 sites envisageables, un facteur de 2 et 2-1/2 entraîne un surcoût de 40 et 60 %, respectivement.

Si les 135 sites envisagés étaient tous retenus, le coût de construction des aérodromes avec chaussée aéronautique en gravier serait de 153,3 millions, le surcoût des accidents à prévoir de 5,4 millions et le surcoût dû à l'exploitation toute l'année d'avions sur roues, de 5,2 millions de dollars. (Les avions sur flotteurs ou skis coûtent plus cher à exploiter que les avions sur roues, mais ils fonctionnent 10 mois sur 12 par an). En contrepartie, il est prévu que les avantages financiers augmenteront de quelque 295 millions de dollars de 1985.

En gros, le programme proposé enrichira le trésor public de 131 M $ en 20 ans.

Prenant en compte les coûts et avantages quantifiables et en se basant sur les prix en vigueur à Winnipeg, il est calculé que le nombre minimal de personnes justifiant le construction d'un aérodrome du type proposé est de 170 si c'est le DHC-6 qui est choisi, et de 220 si c'est le Citation II. Ainsi, des 12 villages mentionnés au début, entre 7 et 9 se qualifient.

En retenant un facteur de surcoût de 2 par rapport aux prix en vigueur à Winnipeg, la population minimale monte à 260 pour le DHC-6, ramenant à 5 le nombre de villages se qualifiant.

On dénombre au Canada entre 78 et 101 villages isolés où la construction d'un aérodrome du type proposé serait économiquement justifiable. De plus il existe d'autres facteurs dont l'effet ne peut être mesuré mais qui, s'ils étaient pris en compte, feraient tomber la population minimale et augmenter le nombre de villages qui se qualifieraient pour la construction d'un aérodrome.

Pour résumer, on dénombre dans les provinces canadiennes quelque 135 villages isolés dont une meilleure desserte aérienne serait avantageuse, notamment un service ambulancier pour le transport aérien des cas d'urgence, cette desserte se faisant grâce aux aérodromes économiques proposés.

Auparavant, une recherche sera nécessaire dans les domaines suivants : accidents sur aérodromes, dimensionnement minimum des pistes et choix de l'avion de référence le mieux adapté dans chacune des provinces. Mais, là où un avion comme le Citation II est déjà utilisé en service ambulancier, il devient plus économique d'élargir le champ d'action que de se concentrer sur un avion comme le DHC-6-300.

Pour ce qui est du choix d'un avion comme le Citation, il serait utile de l'évaluer par rapport à un hélicoptère biturbine rendant les mêmes services ambulanciers, et ce avant d'encourager une province à lancer un programme de construction des aérodromes proposés.

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1.0 INTRODUCTION

1.1 Background

Over a period of several years of conducting air transport planning activities in many Third World or developing nations, it was observed these countries were providing satisfactory low cost air transport to their often remote, small communities. Limited budgets led to their adoption of low cost, no frills designs. Sometimes these solutions were too risky for our situation and also not applicable to our climate and economic conditions. There was however much to consider. This project had its Genesis in this background.

This project's purpose is to improve air access to Canada's remote communities in the Provinces. While equitable access to transportation is a Transport Canada objective, it is particularly difficult to provide for isolated communities. In the Yukon and Northwest Territories, where the Federal Government has jurisdiction, the Arctic Airports Program has been developed to meet this objective. However, there is no similar program encompassing all other remote communities in the provinces. Although intra-provincial transportation is primarily a provincial responsibility, the air mode, often the most economic for such service, falls under federal government responsibility. Hence the findings of this study should be of interest to both levels of government.

Cost and safety are two related problems inhibiting airport development for remote communities. Both connect directly to the standards in effect for the design and construction of airports. Hence, there is a need to undertake research to clarify the relationship between airport design, cost implications and levels of safety, and what such relations indicate for accessibility and service reliability.

This project develops guidelines for the planning, design, construction, operation and maintenance of simple, low cost airports for isolated communities. By focusing on airport cost reduction within acceptable levels of safety, the project's guidelines may lead to increased accessibility to these communities. The "Terms of Reference" are reproduced in Appendix A.

1.2 Project Overview

This project has been conducted in three Phases. Phase 1 was a "pre-feasibility" study for the project. By limiting the scope to a review of airport needs in Manitoba, Phase 1 provided a preliminary estimate of the benefits of improving air access to remote communities through the application of improved, low-cost, remote airport standards. Current minimum airport standards were used to create the first estimate of costs. These figures as applied to Manitoba were extrapolated to the other provinces of Canada, to provide a first estimate of national program construction costs.

Phase 2 developed alternatives for airport construction at remote communities. The alternative airport developments are the result of analysis of: published material; interviews with aircraft operators, aircraft

manufacturers, airport operators and other industry experts; and requests/questionnaires sent to aircraft operators, airport equipment manufacturers and foreign state or national transportation departments.

Through an assessment of: airport construction, equipment and O&M costs; aircraft operating costs; air travel demand; socio-economic benefits and related safety factors, a preferred airport construction alternative was chosen for refined cost:benefit analysis in Phase 3.

A community-specific cost:benefit analysis was carried out in Phase 3. The analysis was based on the Consultant's identification of remote communities in Manitoba requiring new airports. The analysis was used to provide an estimate of a nation-wide program in terms of: net present value costs of construction, equipment purchase and replacement, O&M, aircraft operating and accident costs, and benefits. The analysis included an implementation schedule and a discussion of implementation issues (legal, jurisdictional, financial).

1.3 Scope and Objectives

The project is Provincial in scope. The objectives are:

(i) to develop a reduced-cost minimum standard airport design for remote communities, within adequate safety limits, and

(ii) to estimate the financial implications of implementing a nation-wide program of construction of new airports developed to the recommended guidelines.

1.4 Report Organization

This report is organized in chapters. The first Chapter contains project background material. Chapter 2 presents an overview of the methodology used to determine the scope of remote airport needs. In Chapter 3, the design aircraft used to size the airfield are described. In Chapter 4 a discussion of the airport design methodology is presented. Airport construction program costs and benefits are given in Chapter 5. The following Chapter 6 evaluates implementation issues. A hypothetical 20-year implementation and operation program is given in Chapter 7. Chapter 8 presents conclusions and recommendations.

2.0 METHODOLOGY FOR DETERMINING THE SCOPE OF REMOTE AIRPORT NEEDS

2.1 Use of Manitoba as a Test Region

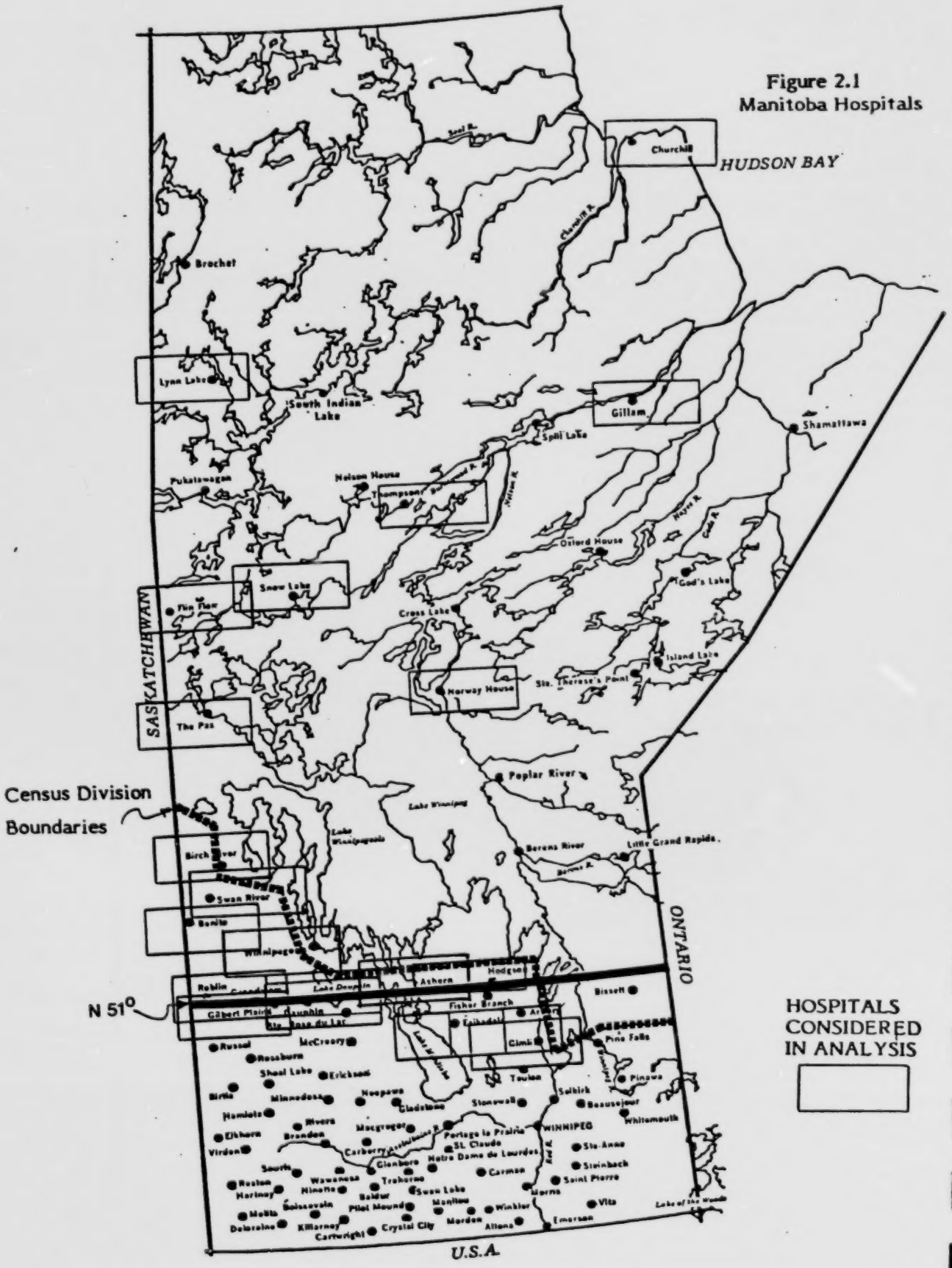
To reduce the amount of analysis required for this study, the northern portion of Manitoba was selected as a pilot region in which to carry out an in-depth analysis. Preliminary contacts with officials from Manitoba indicated that extensive studies had been conducted on Manitoba's remote airports and that Manitoba would be willing to participate. Based on analysis of the CTC Isolated Communities Digest of Social and Economic Data[1], it was found that Manitoba's isolated communities represent a little over a 10% sampling of such communities across the country. In this sample there is a variety of circumstances representative of communities across the nation. It is felt that in-depth research on this Manitoba sample is applicable to other provinces and can be expanded to attain an approximation of the scope of remote airport needs in the other provinces.

2.2 Identification of Remote Communities in Manitoba

Candidate remote communities in Manitoba were identified using a minimum population criterion of 50 persons. The Statistics Canada, Place Name Reference List for the Western Provinces and the Territories[2] was used to determine which communities qualified under this criterion. Based on inspection, it was assumed that communities south of latitude 51 degrees could be eliminated from the analysis. This reduced the number of candidate communities to 97. Communications with Manitoba officials[3] suggested a modified southern limit based on Census Division boundaries. Adoption of this boundary does not change the results of the analysis. Inadequate emergency access to a hospital was considered a key factor in identifying communities that could benefit from the provision of an airport. A recent study[4] has shown that mortality rates caused by emergency medical trauma are significantly reduced as access time to hospitals is reduced. Scrutiny of the road map of Manitoba[5] indicated that the southern part of the province is relatively densely populated and has numerous hospitals which are connected by an extensive network of paved roads. The locations of hospitals in Manitoba, the 51st latitude and the Census Division based boundary, are shown in Figure 2.1, "Manitoba Hospitals". This map shows the location of all the hospitals in the province including some which do not have medical or surgical beds[6]. For the purposes of this study, it was assumed that hospitals not having at least one medical or surgical bed would probably not be equipped to handle serious emergencies. Hence, only those hospitals with surgical or medical beds were considered to provide emergency service to remote communities. There are ten emergency service hospitals meeting the above definition north of the Census Division Line shown in Figure 2.1. These are shown in boxes.

Candidate communities which have their own emergency service hospitals were not included in the analysis. The remaining communities which were subsequently analyzed with respect to road and air transportation to medical facilities are shown in Appendix B. There are 97 sites on this list, 27 of which already have some form of airport. A subsequent field trip to five

Figure 2.1
Manitoba Hospitals



Source: Ref.(6)

northern Manitoba sites confirmed that the current standard to which airports are being constructed by the Manitoba Department of Highways and Transportation was higher than that envisioned by the Consultant for reduced-cost airports. Hence, sites with existing airports were dropped from the analysis, leaving 70 sites for further analysis. Details of the analysis of road and air service to these communities are provided in section 2.2.1.

2.2.1 Analysis of Candidate Communities with Respect to Road and Air Service

The candidate communities are listed in Appendix B, "Candidate Remote Communities". These were analyzed with respect to road and air service to hospitals. For both modes of transportation, a maximum allowable round trip time of four hours, including time at either end (administration time) was assumed. Communities qualify as candidates if the round-trip emergency surface times exceed four hours. Table 2.1, "Assumed Trip Times for Road and Emergency Air Service", shows the assumed speeds and distances that could be travelled by each mode. Three different assumed speeds are shown, one for each type of road. These speeds are averages including any stops or slowdowns at intersections, etc. The average air speeds are block speeds for typical small aircraft such as the DHC-6 Twin Otter. The "administration" times at the ends of the trips, are to dispatch the vehicle, pick up the casualty and transfer the patient from the aircraft/vehicle to the hospital. For air travel these times are assumed to be 0.5 hrs vs 0.25 hrs for road travel. The main reason for this difference is the fact that road service generally provides a door-to-door service, whereas additional travel is usually required to move the casualty between the airport and the hospital or accident site. Additionally, it takes longer for aircraft to get under way than it does road vehicles.

	A Assumed Average Travelling Speed (including stops) (km/hr)	B Admin. Time	C Total One-Way Travelling Time (4hr(Min)-B)÷ 2 (hrs)	D Maximum One-Way Travelling Distance (C x A) (km)
Road "Dirt"	20	0.75 hrs (3** @ 0.25 hrs)	1.625	33
Road "Gravel"	50	0.75 hrs (3** @ 0.25 hrs)	1.625	81
Road "Paved"	60	0.75 hrs (3** @ 0.25 hrs)	1.625	98
Air	278* (150 kts)	1.5 hrs (3** @ 0.50 hrs)	1.250	347

* Aircraft block speed is adjusted when typical aircraft types are used.
** The 3 trip ends are: dispatch, pick-up and drop-off.

Table 2.1 Assumed Trip Times for Emergency Road and Air Service

Source: R.S. Wallace & Associates Ltd.

The trip distances shown in Table 2.1 are maximums based on a single mode of travel only. Where applicable in the analysis, combinations of modes were applied to determine the adequacy of service. Table 2.2, "Analysis of Road Emergency Services Trip Times", shows the 12 remote communities without airports that currently are not adequately served by road. For certain communities, service to hospitals by road is non-existant. These 12 communities were used throughout the project as a basis for detailed cost:benefit analysis. The final results of that analysis are presented in Chapter 5.0 of this Report.

	Latitude	Longitude	Closest Hospital by Road	Service by Road* Paved Dist. (km)	Paved Time (hrs)	Gravel Dist. (km)	Gravel Time (hrs)	Dirt Dist. (km)	Dirt Time (hrs)	Total Return Trip Time by Road** (hrs.)
1 Paunigassi	5152	9533	NONE	-	-	-	-	-	-	-
2 Split Lake 171	5615	9606	THOMPSON	-	-	-	-	130	6.50	13.75
3 Dauphin River 48A	5157	9803	ASHERN	76	1.27	73	1.46	-	-	6.21
4 Wassagomach	5352	9441	NONE	-	-	-	-	-	-	-
5 Grandville Lake	5722	9808	NONE	-	-	-	-	-	-	-
6 Jackhead 43	5154	9718	HODGSON	-	-	20	0.40	60	3.00	7.55
7 Pelican Rapids	5244	10041	SWAN RIVER	50	0.83	-	-	35	1.75	5.91
8 Pine Dock	5125	9705	HODGSON	-	-	100	2.00	-	-	4.75
9 The Narrows 49	5145	9825	ASHERN	76	1.27	20	0.40	-	-	4.09
10 Wabowden	5454	9838	SNOW L.	110	1.83	-	-	-	-	4.41
11 Tadoule Lake	5751	9810	NONE	-	-	-	-	-	-	-
12 Sherridon	5507	10107	NONE	40	0.67	80	1.60	-	-	5.29

* One-way trip times, not including administration time

** Two-way trip times, including administration time

TABLE 2.2 ANALYSIS OF ROAD EMERGENCY SERVICES TRIP TIMES

Source: R.S. Wallace & Associates Ltd.

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3.0 DESIGN AIRCRAFT

3.1 Aircraft Selected

It was necessary to select a design aircraft for the following reasons:

(i) airfield dimensions (particularly runway length) must be adequate to permit safe operations of the design aircraft, and
(ii) total system-wide costs are to include aircraft direct operating costs for emergency and scheduled services. Specific aircraft are required to calculate these costs.

Three aircraft were chosen for analysis. The aircraft selected are typical/representative of the general aircraft types found in the under 5,675 kg (12,500 lb.) maximum gross takeoff weight (MTOW) category. The specific models chosen are not necessarily widely used in all parts of Canada. They are chosen as a basis for a realistic parametric analysis. The aircraft chosen, and the aircraft type each represents, are the following:

(i) single engine piston driven - Cessna 185 Skywagon
(ii) twin engine turboprop - DeHavilland DHC-6 Twin Otter, Series 300
(iii) twin engine jet - Cessna Citation II (6,040 kg; 13,300 lbs)

The above aircraft differ widely in cost, performance and corresponding levels of service offered. Some may not be considered as suitable emergency air ambulance vehicles. Nevertheless all are capable of offering at least minimal service in an emergency and may be readily available. Hence, each aircraft offers a unique level of service (for emergency evacuation) within a unique cost range. Descriptions of each aircraft follow:

3.1.1 Cessna 185

A point form description[7] of this aircraft follows:

- maximum takeoff weight - 1,520 kg (3,350 lbs.)
- flight crew - 1 or 2
- passenger seating capacity - 4 or 5 (or 1 prone casualty, plus medical attendant).
- wing span - 11 m (36 ft.)
- overall length - 8.2 m (27 ft.)
- cabin length - 2.3 m (7.5 ft.) incl. cockpit
- cabin floor width - 0.9 m (2.9 ft.) max, 0.8 m (2.5 ft.) min.
- engine - one normally-aspirated, direct-drive, air-cooled, horizontally-opposed, fuel-injected, six-cylinder engine.
- fuel - 100/130 or 100 LL aviation fuel
- propellor - 3 blade, constant speed, variable pitch
- maximum speed at sea level - 285 km/hr (154 knots)

For medical evacuation, the following comprise the aircraft takeoff weight:

o	standard empty weight	795 kg	(1,752 lbs.)
o	pilot, medical attendant, casualty	204 kg	(450 lbs.)
o	full fuel load	239 kg	(528 lbs.)
o	medical equipment, say	123 kg	(270 lbs.)
		1,361 kg	(3,000 lbs.)

It would be feasible to reduce the allowance for medical equipment and add either one more casualty (seated), co-pilot or medical attendant.

Assuming that refuelling facilities would not be available at a typical remote site, the Cessna 185 would provide minimum (one or two casualty; four hour round trip time) medical evacuation service in a 370 km (200 nautical mile) radius from home base. Thus, all remote communities requiring airports (see Chapter 2.0) could be provided with an air medical evacuation service using Cessna 185 aircraft based at two centres. The most likely choices would be Winnipeg for the southern and Thompson for the northern portions of the region.

3.1.2 DHC-6 Twin Otter Series 300

A point form description[8] of this aircraft follows:

- maximum takeoff weight - 5,670 kg (12,500 lbs.)
- flight crew - 1 or 2
- passenger seating capacity - 20
- wing span - 19.8 m (65 ft.)
- overall length - 15.8 m (51.8 ft.)
- cabin length - 5.6 m (18.4 ft.)
- cabin floor width - 1.3 m (4.3 ft.)
- engines - two Pratt & Whitney Aircraft of Canada Limited PT6A-27, single-stage, free-turbine engines.
- fuel - aviation turbine fuels (JP-1, JP-4), Arctic Diesel Fuel (CPW 46), or in an emergency aviation gasoline may be used, but is restricted to a maximum of 150 hr between engine overhauls.
- maximum speed at sea level - 315 km/hr (170 knots)

For medical evacuation, the following comprise the typical aircraft takeoff weight:

o	standard empty weight	3,239 kg	(7,140 lbs.)
o	pilot, medical attendant, casualty	204 kg	(450 lbs.)
o	fuel	907 kg	(2,000 lbs.)
o	medical equipment, say	186 kg	(410 lbs.)
		4,536 kg	(10,000 lbs.)

More prone casualties could be accommodated (up to four) without compromising the range of the aircraft, within the maximum takeoff weight of 5,670 kg (12,500 lbs.).

Again, assuming that refuelling facilities would not be available at remote sites, the DHC-6 Twin Otter would provide a reasonable level of medical evacuation service in the 460 km (250 nautical mile) range. As per the Cessna 185, complete coverage of remote communities in Manitoba could be provided by operating Twin Otters out of Winnipeg and Thompson.

Neither is it the intention of this study to recommend certain aircraft types for provision of emergency or commercial services, nor is it within its scope to provide an exhaustive list of appropriate aircraft types. There are also a number of aircraft offering service levels which may be regarded as a compromise between the C-185 and DHC-6 aircraft. One such aircraft is the Cessna 208 Caravan. This aircraft provides adequate space for medical services, however, it is a single-engine aircraft. The engine is a turboprop and hence offers a high level of reliability (as opposed to a piston-driven power plant). Other details[9] of the aircraft follow:

- maximum takeoff weight - 3,315 kg (7,300 lbs.)
- flight crew - 1 or 2
- passenger seating capacity - 10
- wing span - 15.8 m (51.7 ft.)
- overall length - 11.5 m (37.6 ft.)
- cabin length - 4.4 m (14.3 ft.)
- cabin floor width - 1.6 m (5.2 ft.)
- engine - one Pratt & Whitney Aircraft of Canada Limited PT6A-114
- maximum cruise speed (@ 3,000 m; 10,000 ft.) - 339 km/hr (183 knots)

3.1.3 Cessna Citation II

The Government of Manitoba has chosen this aircraft to fly medical evacuations, starting in 1985. The aircraft will fly into major northern airports. The Citation II is included in this study to provide an indication of the effects on airport design and hence capital and O&M costs of designing for a high-performance jet aircraft.

In section 4 of the Technical Memorandum a comparison is made between providing emergency air medical services to a hypothetical network of sites by two DHC-6 aircraft and to the same network by one Citation II aircraft. A refined analysis taking into consideration flying hours utilized for other operations could reduce the Citation II's hourly capital and O&M charges to the point where it is more cost effective to use this latter alternative. A brief point form description[10] of the Citation II follows:

- maximum takeoff weight - 6,033 kg (13,300 lbs.)
- flight crew - 2
- passenger seating capacity - 10
- wing span - 15.8 m (51.7 ft.)
- overall length - 14.4 m (47.2 ft.)
- cabin length - 6.4 m (20.9 ft.)
- engines - two Pratt and Whitney Aircraft of Canada JT15D-4 turbofans
- maximum speed at sea level - 484 km/hr (262 knots)

The Citation II could provide adequate coverage based out of Winnipeg only, for all identified remote communities. Flying time to Grandville Lake and return to Winnipeg would be roughly three hours. This does not include administration time. Grandville Lake is the most distant community from

Winnipeg identified in the study (approximately 930 km; 500 nautical miles). For medical evacuation, the following comprise the typical aircraft takeoff weight:

o	standard empty weight	3,264 kg	(7,196 lb.)
o	pilot, medical attendant, casualty	204 kg	(450 lb.)
o	fuel	996 kg	(4,400 lb.)
o	medical equipment, say	206 kg	(454 lb.)
		5670 kg	(12,500 lb.)

Assuming that refuelling facilities would not be available at remote sites, the Citation II would provide medical evacuation coverage in the 1,020 km (550 nautical mile) range.

Each of the above three typical aircraft have unique runway length requirements, depending upon a number of factors, including: aircraft gross takeoff weight; aircraft operating configuration (STOL, non-STOL); runway surface type; airfield elevation; airfield temperature. Figure 3.1 , "Takeoff Length to 15 m - Gravel" illustrates the relationship between some of these factors.

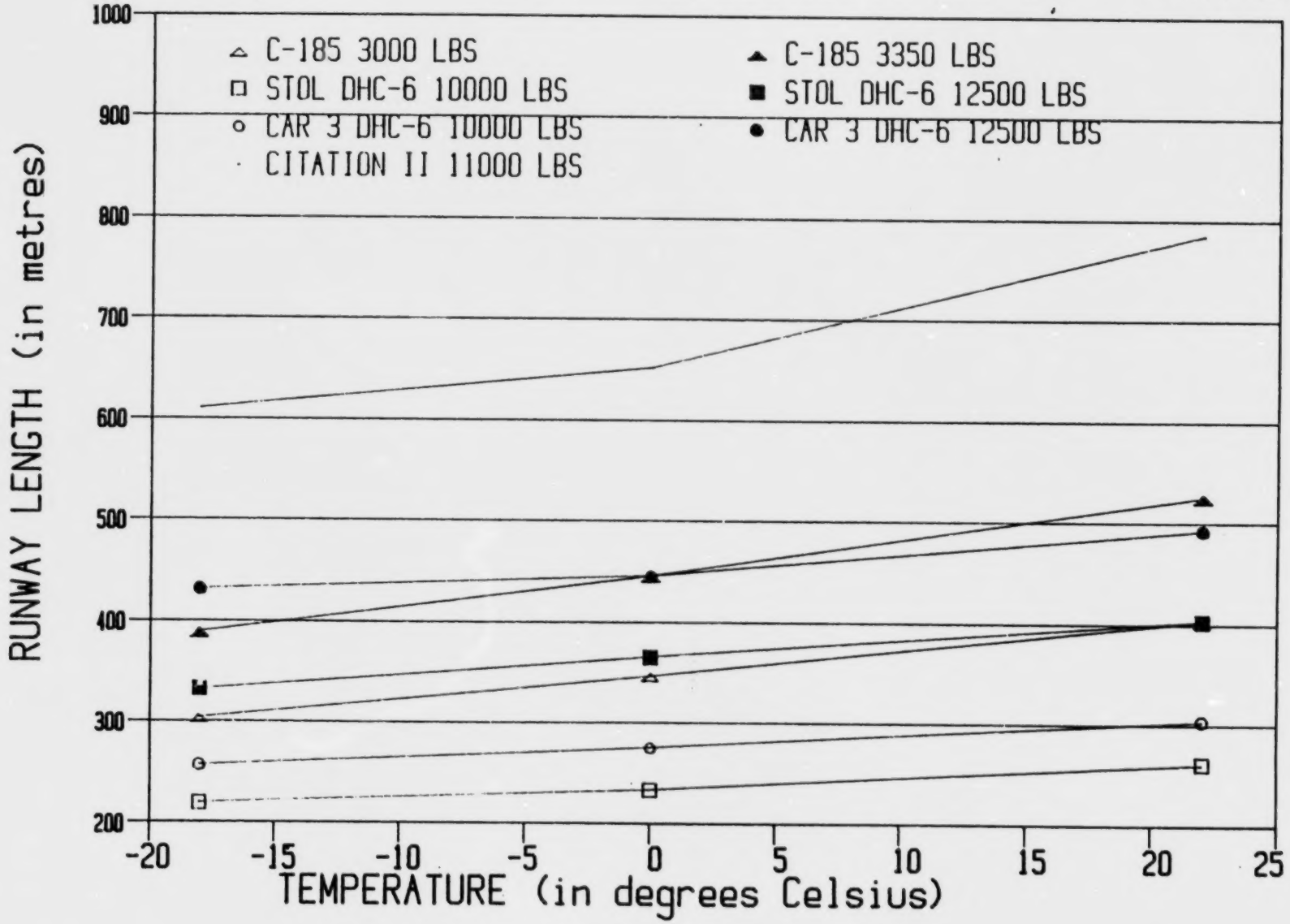
3.2 Comparison with Other Aircraft

The three aircraft chosen for this study are shown in a visual comparison with similar aircraft types in Figure 3.2, "Takeoff Length vs. Maximum Takeoff Weight". This scatter plot shows three aircraft groupings, with two exceptions. Both the DHC-6 (due to its STOL capability) and the Citation II (high thrust to weight ratio) show a minimum airfield length requirement within each group. The consequence of this finding is that, for a given airfield length, location, etc., the DHC-6 and Citation II would be least affected by weight restrictions. These are ideal aircraft for operating into relatively short airfields. The Cessna 182 exhibits similar takeoff length requirements to other aircraft in its class. The complete list of aircraft shown on Figure 3.2 is given in the following Table 3.1:

Aircraft Name	Aircraft Type
Cessna Skywagon II	single engine piston
Mooney 201	single engine piston
Piper Archer II	single engine piston
Piper Saratoga	single engine piston
Cessna Stationair 8	single engine piston
DHC-6-300	twin turboprop
Beech Super King Air B200	twin turboprop
Cessna Conquest II	twin turboprop
Beech King Air F90-1	twin turboprop
Fairchild Merlin IIIC	twin turboprop
Piper Mojave	twin turboprop
Piper Cheyenne IV	twin turboprop
Piper T-1040	twin turboprop
Cessna Citation II	twin turbofan
Gates Learjet 55	twin turbofan
Mitsubishi Diamond 1	twin turbofan
Dassault-Breguet Falcon 100	twin turbofan

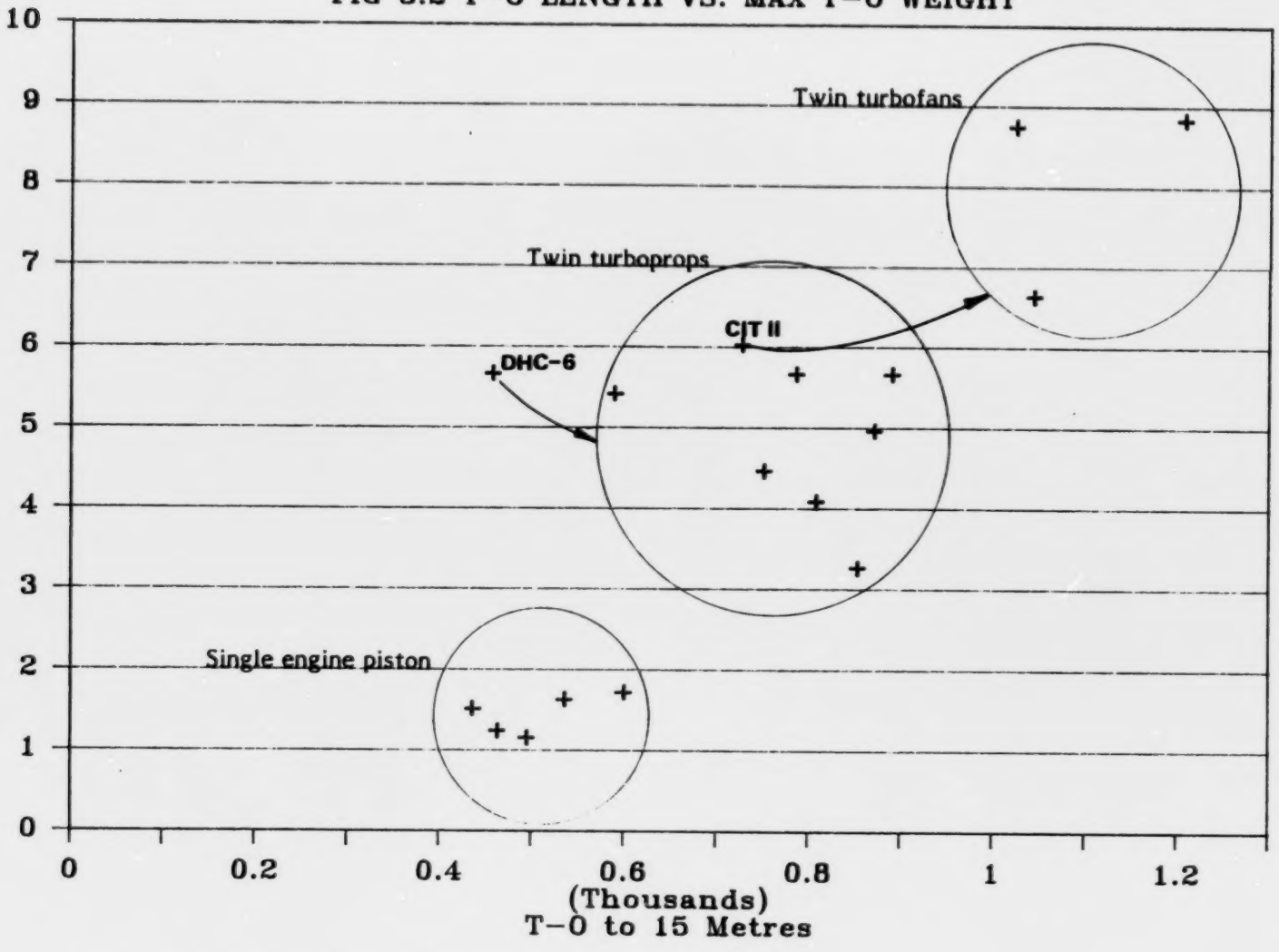
Table 3.1 Aircraft Used in Figure 3.2
Source: R.S. Wallace & Associates Ltd.

FIGURE 3.1: TAKEOFF LENGTHS TO 15 m. - GRAVEL



Source: R.S. Wallace & Associates Ltd.

FIG 3.2 T–O LENGTH VS. MAX T–O WEIGHT



Source: R.S. Wallace & Associates Ltd.

4.0 AIRPORT DESIGN

4.1 Approach to Design of Remote Airports

The purpose of the project is to design a minimal "level of service" airport that can be constructed at the lowest possible cost. The role of this airport is to provide limited commercial air service and emergency air service to communities too small to justify the cost of constructing a normal airport. For the northern Manitoba region, the more conventional airports cost in the neighborhood of $1.5M each. By developing less expensive pavement costing between one-third and one-half the cost for the conventional design, it should be feasible to provide, albeit at a lower level of service, air transport to these small remote communities. Due to the rather remote locations, the design focuses on providing the minimum runway area considered adequately safe to be used by experienced operators. Complementing this minimal runway are the provision of extensive navigational aids, including the provision of a low-powered non-directional beacon (NDB) at each airport. While the design is based on operation under visual meteorological conditions (VMC), an NDB has been provided because of the difficulty in locating small communities in remote areas having no distinctive physical geographical features, especially in the winter time. The design has been carefully selected to accommodate a variety of light aircraft.

4.2 Airfield Design

A modular approach has been taken to developing the various components. These components are divided into:

- civil works: access road, car park, aircraft apron, taxiway, runway and runway strip
- air terminal building and utilities: air terminal building, water supply, sewage, electrical power and heat
- lighting and navigational aids which include: apron, taxiway and runway lights, runway and identification lights; low intensity approach lights; PAPI; lighted wind sock; airport rotating beacon; and a low-powered NDB.

Except for the pavements, the sub-components are standardized for all alternative airport designs. Many of these items are manufactured and will be imported to the site regardless of location. For the pavement types, seven alternatives are presented in terms of description of: pavement section; application to specific site conditions; unit costs; methods of construction; i.e. by imported contractors, or primarily local community self help; accessibility of construction supplies; and finally availability of local construction materials. The pavement section types range from those involving the maximum importation of highly processed materials to the maximum use of local resources and persons. Equipment requirements range from the normal heavy construction equipment to those often available within a small community.

Table 4.1, "Summary of Pavement Alternatives" describes seven alternative sections. The costs shown are relative and will vary with the site conditions.

Table 4.1

Summary of Pavement Alternatives

Pavement		Application Conditions	Minimum Construction Equipment Requirements								Typical Section Required for Pavement to Serve Light Aircraft (DHC-6)	
Type	Description		Dump Trucks	Water Trucks	Grader	Combination Loader/Backhoe	Roller	Disc Harrow	Roto Tiller	Bitumen Distributor	Description of Section	Cost in Dollars per Square Metre*
Gravel Pavement	- conventional pavement using granular aggregates for both base and surface courses.	- used if adequate aggregate is available in proximity to the site.	⊗	⊗	⊗	⊗	⊗				- 200 mm of aggregate	$ 3-4**
Portland Cement Soil-Cement Pavement	- native soil, typically mixed with Portland Cement (4-10% by weight) to form a durable structural layer with slab like properties. - topped with bituminous surface treatment.	- generally used with cohesionless native soils but some clay content is allowable - used if adequate aggregates are not available.		⊗	⊗	⊗	⊗	x	○	⊗	- 145 mm of soil cement - 10% cement by weight - bituminous surface treatment	$5-6
Soil-Bitumen Soil-Cement Pavement	- native soil mixed with Bitumen (4-10% by weight)	- used with cohesionless native soils with no clay present. - used if adequate aggregates are not available.		⊗	⊗	⊗	⊗	x	○	⊗	- 170 mm of soil cement - 6% cement by weight	$6-7
Aggregate Turf Pavement	- mixture of coarse single-sized aggregate (25-35mm) with native soil. - surface is seeded to provide grass wearing surface.	- used with relatively stable native soil such as sand silt or clay. - used if aggregate is limited/costly.	⊗	⊗	⊗	⊗	⊗	x	○		- 200 mm of aggregate-turf pavement with 50% aggregate 50% native material. - grass surface.	$2.50-3.50**

Table 4.1 Cont'd.

Pavement Type	Pavement Description	Application Conditions	Minimum Construction Equipment Requirements: Dump Trucks	Water Trucks	Grader	Combination Loader/Backhoe	Roller	Disc Harrow	Roto Tiller	Bitumen Distributor	Typical Section Required for Pavement to Serve Light Aircraft (DHC-6): Description of Section	Cost in Dollars per Square Metre*
Screen-Stone Paving Block Pavement	- cast on site screen stone (webbed) paving blocks, placed on bedding material on sub-grade. - voids in screen stone are filled with topsoil and seeded.	- used if adequate aggregates are not available. - used if inexpensive labour can be found to cast paving blocks on site and place them.	X		⊗	⊗	⊗				- 100 mm concrete paving blocks with minimal bedding. - grass surface in voids of paving block.	$26
Aluminum Landing Mat Pavement	- prefabricated aluminum planks linked together and placed on subgrade.	- used if adequate aggregates are not available. - used if labour is relatively expensive.			⊗		⊗				- 100 mm aluminum planks on subgrade.	$71***
Geoweb Pavement	- prefabricated plastic lattice geoweb placed on subgrade, filled with native material and topped with bituminous surface treatment.	- used if adequate aggregates are not available. - used if native material is anything but organic soil.		⊗	⊗	⊗	⊗			⊗	- 100 mm geoweb filled with native soil. - bituminous surface treatment.	$11-12

* Unless otherwise indicated, pavement costs are based on materials, labour and equipment costs for Winnipeg/Southern Ontario (see Appendix A).
** Based on aggregate haul distance of 5 km at $0.10 per tonne km.
*** Includes cost of transporting prefabricated plank.
X Minimum Equipment Normally Required by Contractor.
○ Minimum Equipment Required if Community Members participate in Construction.
⊗ Minimum Equipment Required Either by Contractor or by Community Members.

Source: R.S. Wallace & Associates Ltd.

Some types are conventional while others described are more exotic. Each would be evaluated for a site and the most cost effective selected.

4.2.1 Design Criteria

The primary references for the new design criteria are:

- Transport Canada's Aerodrome Standards and Recommended Practices, TP 312E Second Edition, August 1984[11] and the three Aircraft Manufacturer's Operational Manuals.[7,8,10]

Several deviations were made from the TP 312E standards in those areas which would result in reduced costs without reducing safety in any identifiable way, and keeping in mind that the airports are to be used by experienced aircraft operators.

A comparison between the Consultant's Recommended Guidelines and relevant Transport Canada standards is presented in Table 4.2, "Comparison of TC Standards and Consultant's Guidelines".

The Consultant proposes to modify the transverse slopes beyond the initial 3 m to allow up to a 10% slope in fill areas. For the types of aircraft using the runways, this 10% slope is considered to present no significant hazard. A previous study[12] indicated that significant runway construction cost savings will result from using a 10% slope in fill areas.

In addition to the proposed modifications to the geometric standards, the Consultant is proposing a unique application of full-strength and reduced-strength pavement sections to reduce costs. This matter is not covered in TP 312E. It is shown in the following typical design sketches. The Consultant's design incorporates full strength pavement on the runway ends, i.e. the touchdown zones, and a central strip for the full length of the balance of the runway (either 7.5 m or 9 m wide depending upon the design aircraft chosen). The reduced strength pavement proposed is turf or aggregate turf which are adequate to support all three of the design aircraft types under normal operating conditions. Neither offers any hazard.

In the Consultant's designs no provision has been made for installation of pavement edge drainage as a standard item. However, each site should be examined and where required, the lowest cost drains should be installed. For some locations this may mean use of filter fabric filled with crushed rock in a drainage trench rather than installing perforated drain pipes.

The airports are proposed to be used for day and night VMC, not IMC. However, as discussed earlier, a low-power non-directional beacon, plus extensive visual navigational aids to improve the site locatability and safety when used under marginal visibility conditions, have been included.

A typical remote airport layout is shown in Figures 4.1 and 4.2, "Typical Remote Airport Configuration". Figure 4.3 shows airspace requirements; Figure 4.4 shows approach and lateral clearances.

Item	TC Standard	Consultant's Recommended Guidelines
1. Runway width		
- C-185/DHC-6	15 m/18 m	15 m full-strenth section 7.5 m reduced-strength section
- Cit II	18 m	18 m full-strength section 9 m reduced-strength section
2. Strip beyond pavement ends	30 m	30 m
3. Strip width	60 m	60 m
4. Graded area width	38 m	38 m
5. Transverse slope (downward)		
- 1st 3m beyond pavement edge	5%	5%
- remaining slope	3%	10%
6. Taxing width		
- C-185/DHC-6	7.5 m/10.5 m	7.5 m
- Cit II	10.5 m	10.5 m
7. Taxiway strip width	27 m	27 m
8. Taxiway shoulder		
- width	-	3.25 m
- slope	-	5%
9. Transitional zone slope (from runway strip edge)	20%	20%
10. Distance from pavement edge to building or object	7.5 m	7.5 m
11. Approach surface		
- divergence	10%	10%
- slope	5%	5%
12. Lighting		
- low intensity runway edge, end, threshold	required	edge only required
- low intensity taxiway edge	required	required
- airport beacon	required	required
- wind direction indicator	required	required
- low intensity approach	optional	optional
- approach slope indicator	optional	PAPI required (APAPI optional)
- runway end identification	optional	required
- standby power	optional	required if primary, otherwise optional power source
- apron lighting	optional	required

Table 4.2 **Comparison of TC Standards and Consultant's Guidelines**
Source: Ref(11), R.S. Wallace & Associates Ltd.

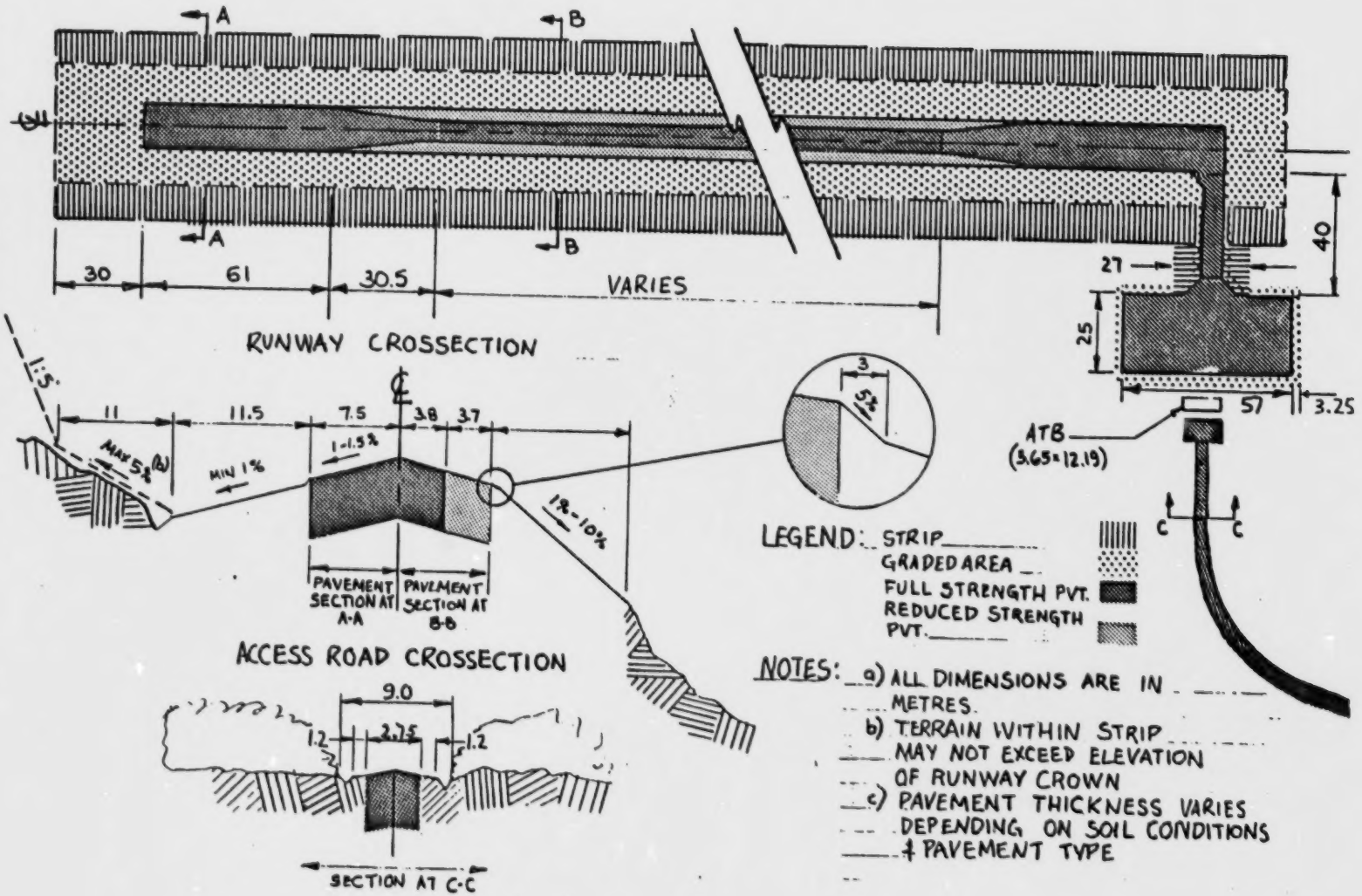


Figure 4.1 Typical Remote Airport Configuration (C-185/DHC-6 Type)

Source: R.S. Wallace & Associates Ltd.

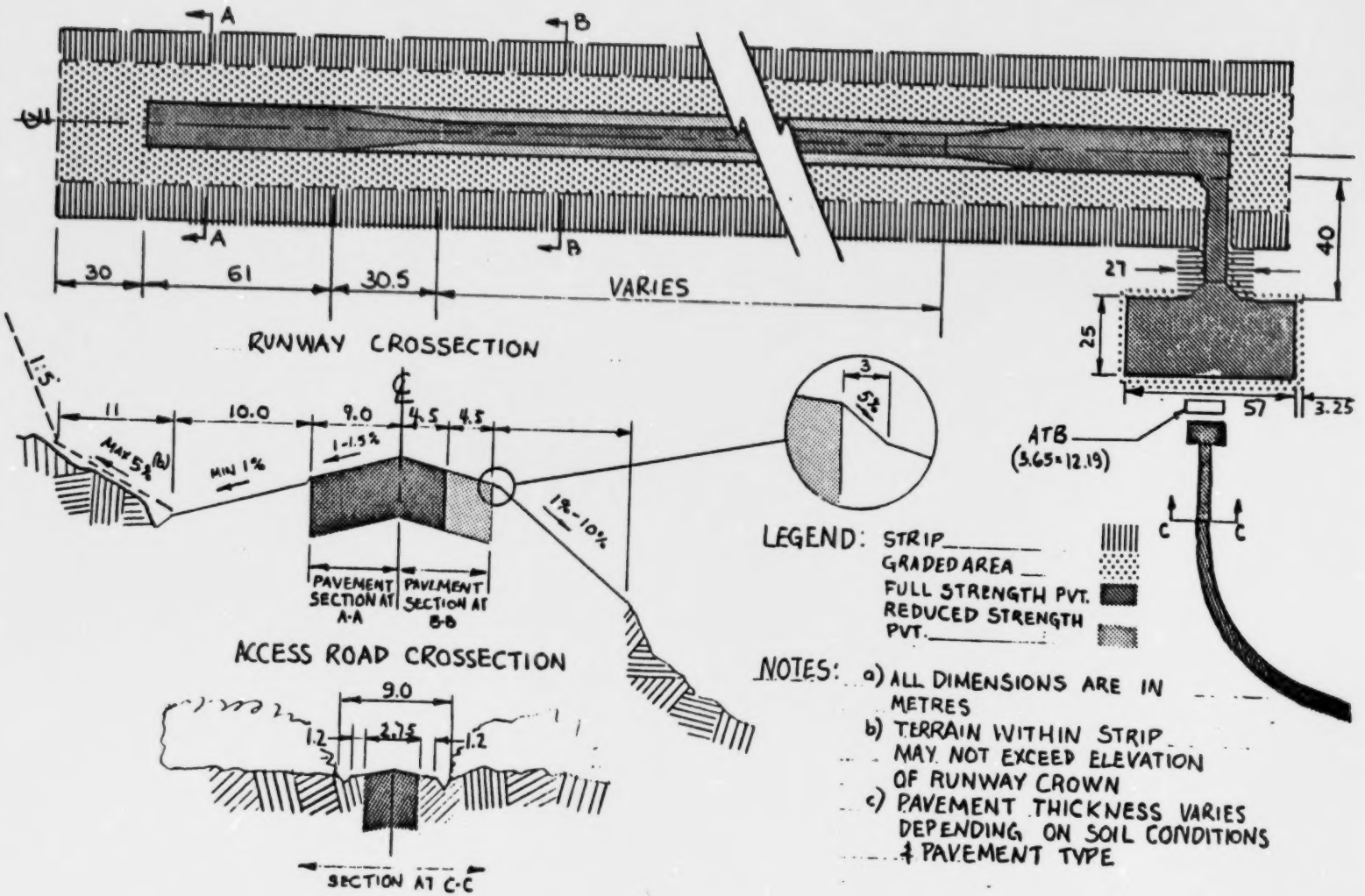


Figure 4.2 Typical Remote Airport Configuration (Citation II Type)

Source: R.S. Wallace & Associates Ltd.

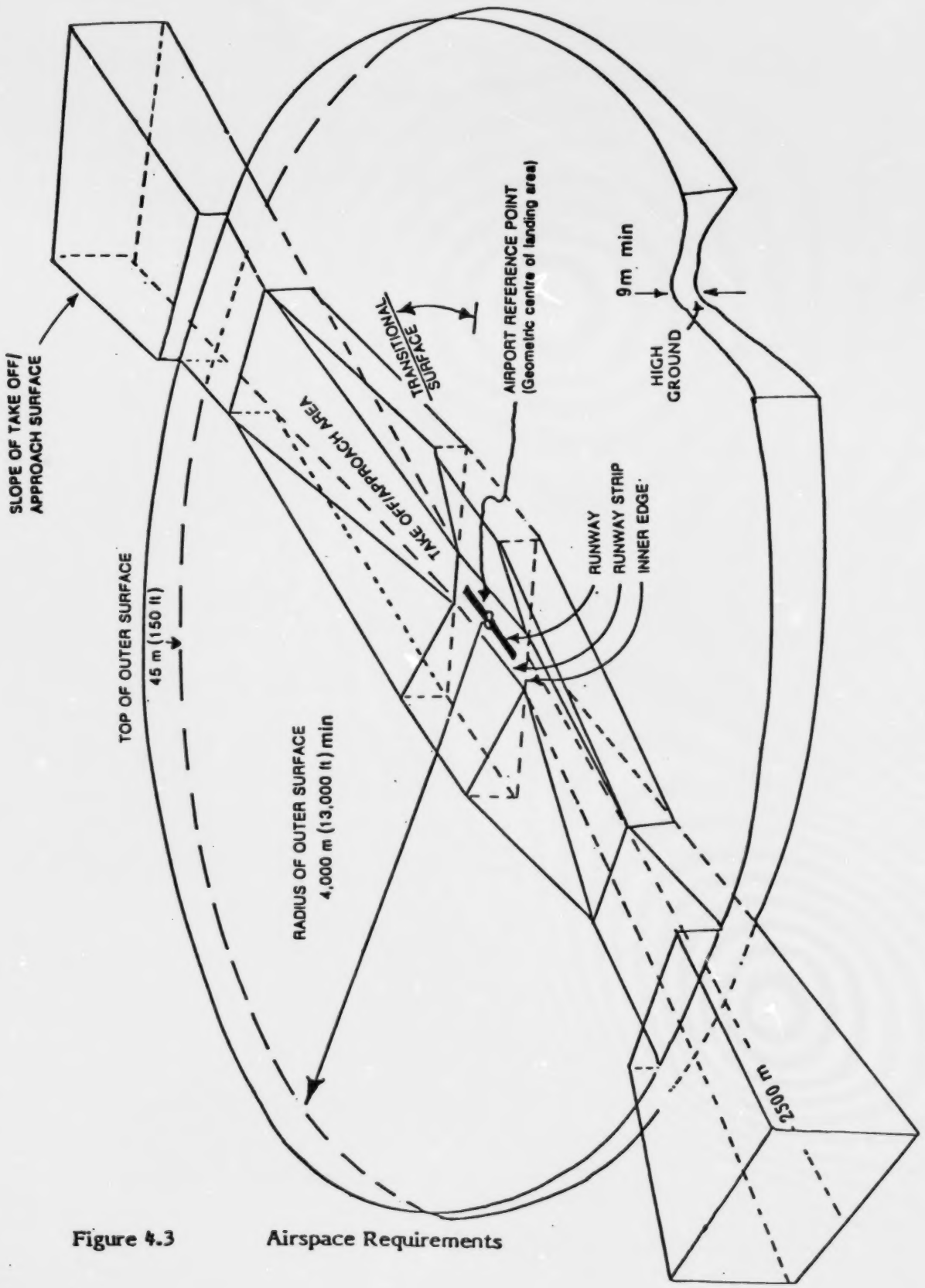


Figure 4.3 Airspace Requirements

Source: Ref.(11)

Figure 4.4 Approach and Lateral Clearances

Source: Ref.(11)

In some respects, primarily length and width, the proposed runway designs are considerably less than those currently being constructed by: the Province of Manitoba, many other provinces, and the Federal Government for Twin Otter type operations. In light of the very low frequency of accidents recorded at airports under 915 m (3,000 ft.) in Canada, there is some evidence of over emphasis on safety at the expense of higher cost of construction and maintenance. For the air mode the acceptable risk vs. other modes appears to be much lower. Using as a measure of safety, "fatalities per passenger-km travelled" scheduled air operations are approximately 12.5 times safer than travel by road vehicles. It is contended the welfare of the nation will be improved by lowering air standards to make resources available to other sectors offering much higher improvements in safety, health, etc. However, lack of valid data prevents making a precisely quantified risk assessment for the air mode at this time.

4.2.2 Costs of Construction

Individual site conditions will vary markedly from the average condition used as a basis of costing. References used for costing have been taken from Transport Canada's Construction Cost Reference Data Base for CATA Airport Facilities (Tp 3218)[13]; manufacturer's costs; discussions with contractors and transportation companies; the Manitoba government and their operators. Officials in the Manitoba government have indicated that for construction of provincial airports in the north, the costs are often very high relative to Transport Canada's average costs in the south due to the remoteness of the location and non-access by ground during the normal construction season. This results in equipment being brought in on winter roads one year and remaining for a full construction season then being brought out the following winter on a new winter road. For sites having all weather roads, or at least a road open in the summer, these delay costs should not be markedly higher than for the southern part of the province. Manitoba officials have indicated that costs are often two to two and a half times higher than those in the Winnipeg area. In this study eight of twelve sites identified for new construction are currently served by all weather roads. Twenty-one airports in the northern Manitoba region don't have all weather roads.

A comparison between the proposed design and a typical current design for airfield pavements is shown in Table 4.3, "Design and Capital Cost Comparison for Airfield Side Recommended Remote Airport Design vs. TC Typical Remote Airport Design".

Costs shown in this Table are based on common unit prices. Actual costs at a given site will vary but the relative relationship will remain. This comparison indicates there is a potential saving of about $450,000 per site for the airfield pavement sections. When extrapolated to the national scene numbering some 135 sites the expected savings become large and worth achieving.

	Recommended Design	TC Design
Strip Length	426 m	1,034 m
Graded Area Width	38 m	44 m
Runway Pavement Length	366 m	930 m
Runway Pavement Width	7.6 m to 15.2 m	23 m
Taxiway Length	40 m	40 m
Taxiway Width	7.5 m	10.5 m
Runway Cost (Gravel)	$ 244,579	$ 689,948
Taxiway Cost (Gravel)	$ 3,600	$ 3,600
Aircraft Apron Cost (Gravel)	$ 18,588	$ 18,588
Total Airfield Side Cost	$ 266,767	$ 712,136

Cost Savings of Recommended Design $445,369

Table 4.3 **Design and Capital Cost Comparison for Airfield Side Recommended Remote Airport Design vs. TC Typical Remote Airport Design**

Source: Ref.(11), R.S. Wallace & Associates Ltd.

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5.0 PROGRAM COSTS AND BENEFITS

5.1 Introduction

A detailed cost:benefit analysis was carried out to determine the net present value effects of airport construction, airport and aircraft operation, and equipment purchase. The analysis was performed on each of the 12 remote Manitoba sites identified as requiring new airports. The analysis was done for both the recommended design standard, and that required for Citation II operations. The Manitoba analysis was used as a basis for estimating the costs and benefits of a nationwide program of new airport construction at remote sites.

5.2 Cost Increase Factors Not Included

5.2.1 Manitoba Communities

The detailed analysis printout for the 12 Manitoba communities is contained in Appendix C, "Cost:Benefit Calculations - Manitoba Communities". The following should be noted when reading the tables:

(i) construction costs are based on Winnipeg prices. No attempt has been made to develop site-specific construction cost increase factors.

(ii) both runway resurfacing costs and airport O&M costs are derived based on the assumption that reduced strength pavement (gravel, aggregate-turf, screen-stone paving block) and full-strength pavement (Portland cement soil cement, bitumen cement soil cement, aluminum landing mat, geoweb) would have a typical unit or fixed cost. Resurfacing costs for aggregate-turf are slightly higher than those of the other two reduced-strength pavements because this surface is applied full-width over the entire runway length. Resurfacing costs for aluminum landing mat are nil because it was assumed this surface would not require replacement.

(iii) annual incremental aircraft direct operating costs were calculated over the base case of providing a ski/float service 10 months of the year.

The total present value incremental benefits and costs for each community are given in Table 5.1, "Recommended Airport Design - Summary of Incremental Costs and Benefits for Manitoba Remote Airports" and Table 5.2, "Citation II Airport Design - Summary of Incremental Costs and Benefits for Manitoba Remote Airports". This information is repeated graphically in Figure 5.1, "Manitoba Remote Airports - Population vs. NPV" and Figure 5.2, "Manitoba Remote Airports - Population vs. B:C Ratio". Note that for the DHC-6 design communities with populations less than roughly 170 have negative net present value (NPV) calculations, and benefit:cost (b:c) ratios less than 1.0. NPV and b:c values rise with increasing population. The aggregate b:c ratio for the 12 communities is 1.8:1.0. The b:c calculations are based on Winnipeg prices. Application of site-specific cost increase factors would cause the b:c ratios to deteriorate slightly.

PAVEMENT TYPE: GRAVEL
RUNWAY LENGTH: 372m.
RUNWAY WIDTH: 7.6m. TO 15.2m.

MANITOBA COMMUNITY	POPULATION	PV INCREMENTAL BENEFITS	PV INCREMENTAL COSTS	NPV	NORMAL RISK INCRMNTL B/C RATIO	HIGH RISK INCRMNTL B/C RATIO
PAUNNIGASI	266	$1,694,000	$1,202,000	$492,000	1.41	1.38
SPLIT LAKE	1026	$6,288,000	$1,343,000	$4,945,000	4.68	4.46
DAUPHIN RIVER	97	$595,000	$1,156,000	($561,000)	0.52	0.51
WASSAGOMACH	660	$4,076,000	$1,277,000	$2,799,000	3.2	3.08
GRANDVILLE LAKE	90	$552,000	$1,154,000	($602,000)	0.48	0.48
JACKHEAD	199	$1,289,000	$1,190,000	$99,000	1.08	1.06
PELICAN RAPIDS	236	$1,513,000	$1,197,000	$316,000	1.26	1.24
PINE DOCK	105	$645,000	$1,158,000	($513,000)	0.56	0.55
THE NARROWS 49	452	$2,819,000	$1,237,000	$1,582,000	2.28	2.21
WABOWDEN	650	$4,015,000	$1,272,000	$2,743,000	3.16	3.04
TADOULE LAKE	250	$1,598,000	$1,199,000	$399,000	1.33	1.31
SHERRIDON	167	$1,096,000	$1,184,000	($88,000)	0.93	0.91
TOTAL	4198	$26,180,000	$14,569,000	$11,611,000	1.80	n.a.

1. Medical evacuation portion of costs based on DHC-6 service

TABLE 5.1 RECOMMENDED AIRPORT DESIGN-SUMMARY OF INCREMENTAL COSTS AND BENEFITS FOR MANITOBA REMOTE AIRPORTS (1.)

SOURCE: R.S.WALLACE & ASSOCIATES LTD.

PAVEMENT TYPE: GRAVEL
RUNWAY LENGTH: 785m.
RUNWAY WIDTH: 9.1m. TO 18m.

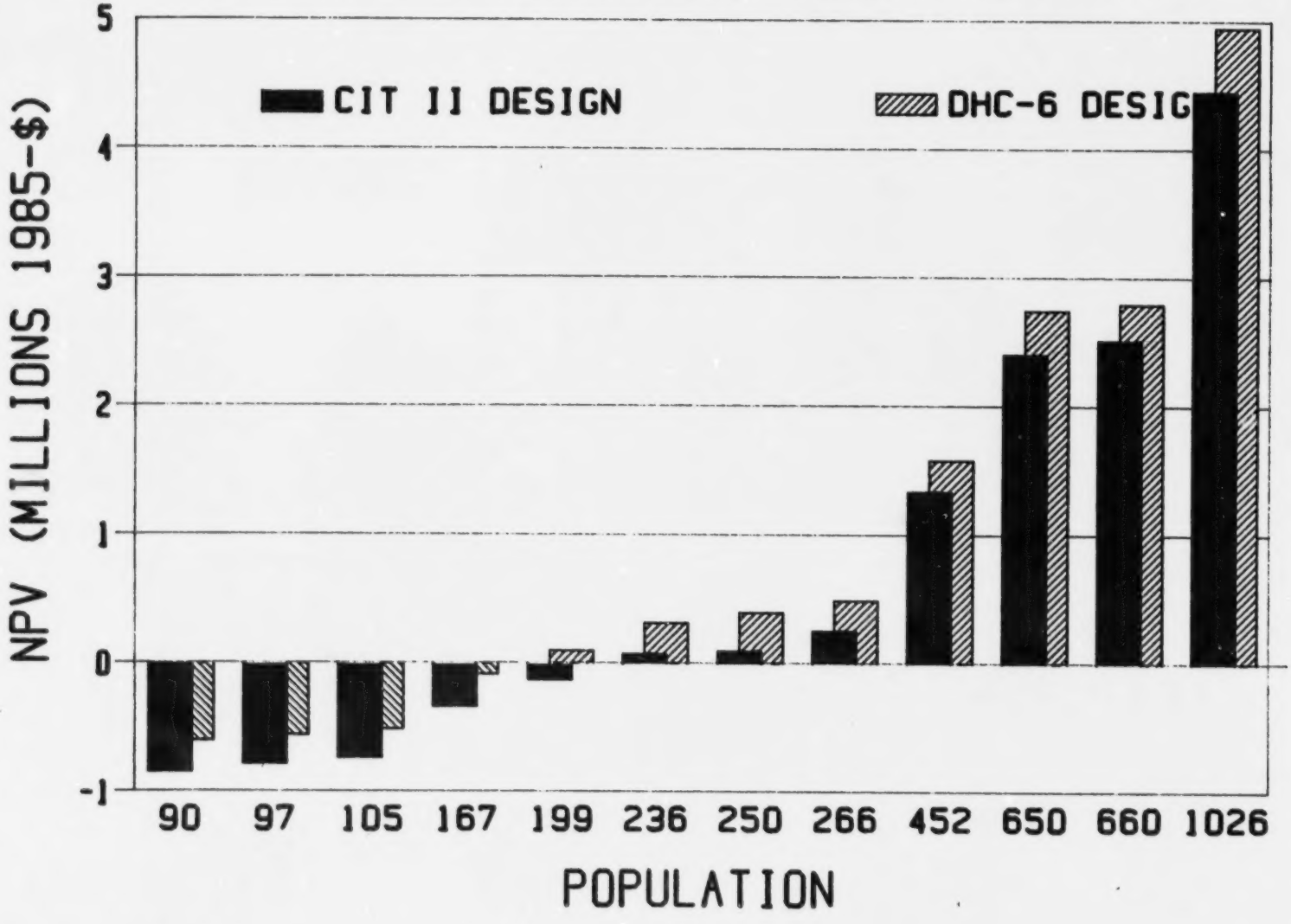
MANITOBA COMMUNITY	POPULATION	PV INCREMENTAL BENEFITS	PV INCREMENTAL COSTS	NPV	NORMAL RISK INCRMNTL B/C RATIO	HIGH RISK INCRMNTL B/C RATIO
PAUNNIGASI	266	$1,694,000	$1,437,000	$257,000	1.18	1.16
SPLIT LAKE	1026	$6,288,000	$1,831,000	$4,457,000	3.43	3.31
DAUPHIN RIVER	97	$595,000	$1,382,000	($787,000)	0.43	0.43
WASSAGOMACH	660	$4,076,000	$1,557,000	$2,519,000	2.62	2.54
GRANDVILLE LAKE	90	$552,000	$1,402,000	($850,000)	0.39	0.39
JACKHEAD	199	$1,289,000	$1,420,000	($131,000)	0.91	0.89
PELICAN RAPIDS	236	$1,513,000	$1,436,000	$77,000	1.05	1.04
PINE DOCK	105	$645,000	$1,384,000	($739,000)	0.47	0.46
THE NARROWS 49	452	$2,819,000	$1,479,000	$1,340,000	1.91	1.86
WABOWDEN	650	$4,015,000	$1,611,000	$2,404,000	2.49	2.42
TADOULE LAKE	250	$1,598,000	$1,498,000	$100,000	1.07	1.05
SHERRIDON	167	$1,096,000	$1,436,000	($340,000)	0.76	0.75
TOTAL	4198	$26,180,000	$17,873,000	$8,307,000	1.46	n.a.

1. Medical evacuation portion of costs based on Citation-II service

TABLE 5.2 CITATION II AIRPORT DESIGN-SUMMARY OF INCREMENTAL COSTS AND BENEFITS FOR MANITOBA REMOTE AIRPORTS(1.)

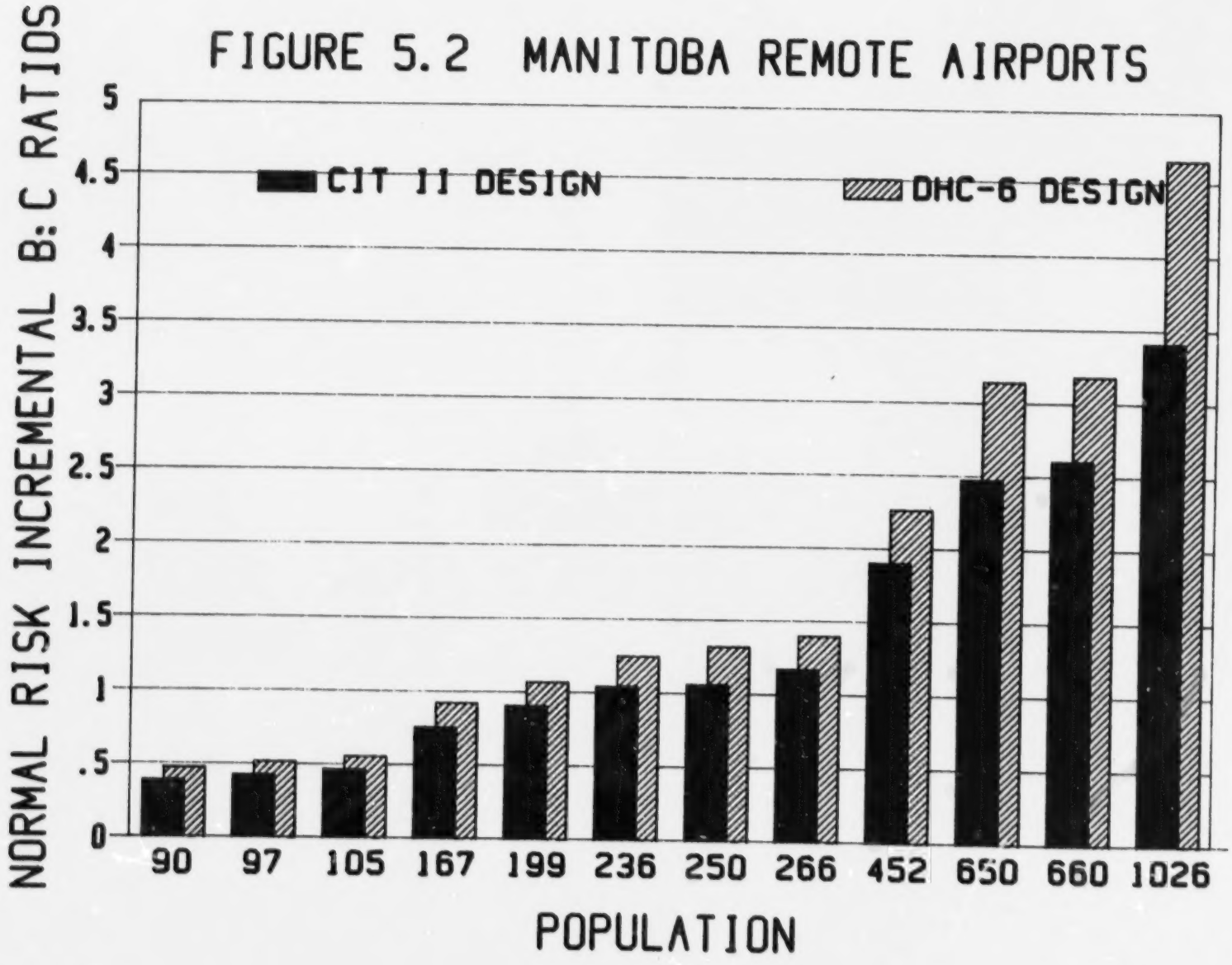
SOURCE: R.S.WALLACE & ASSOCIATES LTD.

FIGURE 5.1 MANITOBA REMOTE AIRPORTS



Source: R.S. Wallace & Associates Ltd.

FIGURE 5.2 MANITOBA REMOTE AIRPORTS



Source: R.S. Wallace & Associates Ltd.

For an airport designed to accommodate Citation II operations, a slightly higher population (roughly 220) is required to yield a positive NPV or a b:c ratio greater than 1.0:1.0. The aggregate b:c ratio for the 12 communities is then 1.46:1.00.

5.2.2 Nationwide Program

The Consultant estimates there are some 1,700 communities in "remote" parts of Canada's provinces. To estimate the number of airports required in the other provinces, the results for Manitoba's 12 new airports were factored up according to the numbers of communities in "remote" parts of the remaining provinces. To do this some assumptions with regard to "remote" parts of the provinces were made. The "remote" part of Manitoba was assumed to be the section north of latitude 51°. The remote parts of other provinces were determined largely by inspection of road maps. The numbers of communities in remote parts of Quebec and Newfoundland were adjusted based on judgement. The total number of new airports required was calculated by applying the proportions of communities in remote areas of Manitoba requiring new airports (8%) to the rest of the provinces.

The cost of constructing, operating and maintaining (for a 20-year period) new airports at remote sites across all of the provinces is given in Tables 5.3 and 5.4, "Airports and Costs for Provinces Extrapolated from Manitoba Data". The costs given in Table 5.3 reflect the recommended design; the costs in Table 5.4 reflect a design to accommodate Citation II operations.

5.3 With Cost Increase Factors

The analysis of Section 5.2.1 when modified to provide for cost increase factors reflect increased construction costs due to site remoteness. The factors (either 2.0 or 2.5) are applied in the following manner:

(i) directly to all civil works costs
(ii) to labour and equipment components only for construction and installation of: the ATB and related utilities; lighting and navigational aids.

5.3.1 Manitoba Communities

The effect of the cost factors is shown in Tables 5.5 and 5.6, "Recommended Airport Design - Summary of Incremental Factored Costs and Benefits for Manitoba Remote Airports".

The cost increase factors have the effect of decreasing the Manitoba system NPV and b:c ratios. The factor 2.0 decreases NPV and b:c by 48% and 28% respectively; the factor 2.5 by 72% and 37% respectively. Figure 5.3, "Manitoba Remote Airports - Population vs. NPV (Recommended Airport Design -Including Cost Factors)", and Figure 5.4, "Manitoba Remote Airports -Population vs. B:C Ratio (Recommended Airport Design - Including Cost Factors)", illustrate the effect that inclusion of construction cost factors have on the relationship between population, NPV and b:c. Population required to produce a positive NPV, or b:c ratio greater than 1.0:1.0, is increased as the cost factors increase.

Province	Remote Part of Province	No. of Communities in Remote Part of Province	No. of New Airports Required
Manitoba	north of 51°	150	12 (3)
Saskatchewan	north of 53°	217	17 (4)
Alberta	north of 55°	136	11 (4)
British Columbia	north of 53°	326	26 (4)
Ontario	north of 40°	165	13 (4)
Quebec	north of 48° (excluding Gaspé)	400 (1)	32 (4)
Newfoundland	80%	300 (2)	24 (4)
Prince Edward Island	none	0	0 (4)
Nova Scotia	none	0	0 (4)
New Brunswick	none	0	0 (4)
Total		1,694	135

Net Present Value of 135 new airports	= **$153,273,060**(5)
Adding incremental accident costs	= $158,651,190
Adding incremental accident and operating costs	= $163,903,500

(1) Figure reduced by about 480 to eliminate the Gaspé, plus additional adjustments based on judgement of the consultant.
(2) Figure reduced by 322 based on judgement of the consultant.
(3) Number of airports in Manitoba based on Consultant's analysis.
(4) Factored based on Manitoba ratio of no. of airports to no. of communities in remote part of province.
(5) Ave. cost from Phase II analysis; Winnipeg costs; gravel pavement; runway length = 372 m; does not include aircraft accident costs & operating costs (DHC-6 emerg. service; DHC-6/C-185 reg. service)

Table 5.3 Airports and Costs for Provinces Extrapolated from Manitoba Data (DHC-6)

Source: R.S. Wallace & Associates Ltd.

Province	Remote Part of Province	No. of Communities in Remote Part of Province	No. of New Airports Required
Manitoba	north of 51°	150	12 (3)
Saskatchewan	north of 53°	217	17 (4)
Alberta	north of 55°	136	11 (4)
British Columbia	north of 53°	326	26 (4)
Ontario	north of 40°	165	13 (4)
Quebec	north of 48° (excluding Gaspé)	400 (1)	32 (4)
Newfoundland	80%	300 (2)	24 (4)
Prince Edward Island	none	0	0 (4)
Nova Scotia	none	0	0 (4)
New Brunswick	none	0	0 (4)
Total		1,694	135

Net Present Value of 135 new airports = **$183,255,750**(5)

Adding incremental accident costs = $188,633,880

Adding incremental accident and operating costs = $201,083,040

(1) Figure reduced by about 480 to eliminate the Gaspé, plus additional adjustments based on judgement of the consultant.
(2) Figure reduced by 322 based on judgement of the consultant.
(3) Number of airports in Manitoba based on Consultant's analysis.
(4) Factored based on Manitoba ratio of no. of airports to no. of communities in remote part of province.
(5) Ave. cost from Phase II analysis; Winnipeg costs; gravel pavement; runway length = 785 m; does not include aircraft accident costs & operating costs (Citation II 6 emerg. service; DHC-6/C-185 reg. service)

Table 5.4 Airports and Costs for Provinces Extrapolated from Manitoba Data (Citation II)

Source: R.S. Wallace & Associates Ltd.

PAVEMENT TYPE: GRAVEL
RUNWAY LENGTH: 372m.
RUNWAY WIDTH: 7.6m. TO 15.2m.

MANITOBA COMMUNITY	POPULATION	PV INCREMENTAL BENEFITS	PV INCREMENTAL COSTS	NPV	NORMAL RISK INCRMNTL B/C RATIO	HIGH RISK INCRMNTL B/C RATIO
PAUNNIGASI	266	$1,694,000	$1,670,000	$24,000	1.01	1.00
SPLIT LAKE	1026	$6,288,000	$1,810,000	$4,478,000	3.47	3.35
DAUPHIN RIVER	97	$595,000	$1,623,000	($1,028,000)	0.37	0.37
WASSAGOMACH	660	$4,076,000	$1,745,000	$2,331,000	2.34	2.27
GRANDVILLE LAKE	90	$552,000	$1,622,000	($1,070,000)	0.34	0.34
JACKHEAD	199	$1,289,000	$1,657,000	($368,000)	0.78	0.77
PELICAN RAPIDS	236	$1,513,000	$1,665,000	($152,000)	0.91	0.90
PINE DOCK	105	$645,000	$1,625,000	($980,000)	0.40	0.39
THE NARROWS 49	452	$2,819,000	$1,704,000	$1,115,000	1.65	1.62
WABOWDEN	650	$4,015,000	$1,740,000	$2,275,000	2.31	2.25
TADOULE LAKE	250	$1,598,000	$1,667,000	($69,000)	0.96	0.94
SHERRIDON	167	$1,096,000	$1,651,000	($555,000)	0.66	0.66
TOTAL	4178	$26,180,000	$20,179,000	$6,001,000	1.30	n.a.

1. Medical evacuation portion of costs based on DHC-6 service

TABLE 5.5 RECOMMENDED AIRPORT DESIGN-SUMMARY OF INCREMENTAL FACTORED COSTS AND BENEFITS FOR MANITOBA REMOTE AIRPORTS (1.)

FACTOR = 2.0

SOURCE: R.S.WALLACE & ASSOCIATES LTD.

PAVEMENT TYPE: GRAVEL
RUNWAY LENGTH: 372m.
RUNWAY WIDTH: 7.6m. TO 15.2m.

MANITOBA COMMUNITY	POPULATION	PV INCREMENTAL BENEFITS	PV INCREMENTAL COSTS	NPV	NORMAL RISK INCRMNTL B/C RATIO	HIGH RISK INCRMNTL B/C RATIO
PAUNNIGASI	266	$1,694,000	$1,903,000	($209,000)	0.89	0.88
SPLIT LAKE	1026	$6,288,000	$2,044,000	$4,244,000	3.08	2.98
DAUPHIN RIVER	97	$595,000	$1,857,000	($1,262,000)	0.32	0.32
WASSAGOMACH	660	$4,076,000	$1,978,000	$2,098,000	2.06	2.01
GRANDVILLE LAKE	90	$552,000	$1,855,000	($1,303,000)	0.30	0.30
JACKHEAD	199	$1,289,000	$1,891,000	($602,000)	0.68	0.67
PELICAN RAPIDS	236	$1,513,000	$1,898,000	($385,000)	0.80	0.79
PINE DOCK	105	$645,000	$1,859,000	($1,214,000)	0.35	0.35
THE NARROWS 49	452	$2,819,000	$1,938,000	$881,000	1.45	1.43
WABOWDEN	650	$4,015,000	$1,973,000	$2,042,000	2.03	1.99
TADOULE LAKE	250	$1,598,000	$1,900,000	($302,000)	0.84	0.83
SHERRIDON	167	$1,096,000	$1,885,000	($789,000)	0.58	0.58
TOTAL	4198	$26,180,000	$22,981,000	$3,199,000	1.14	n.a.

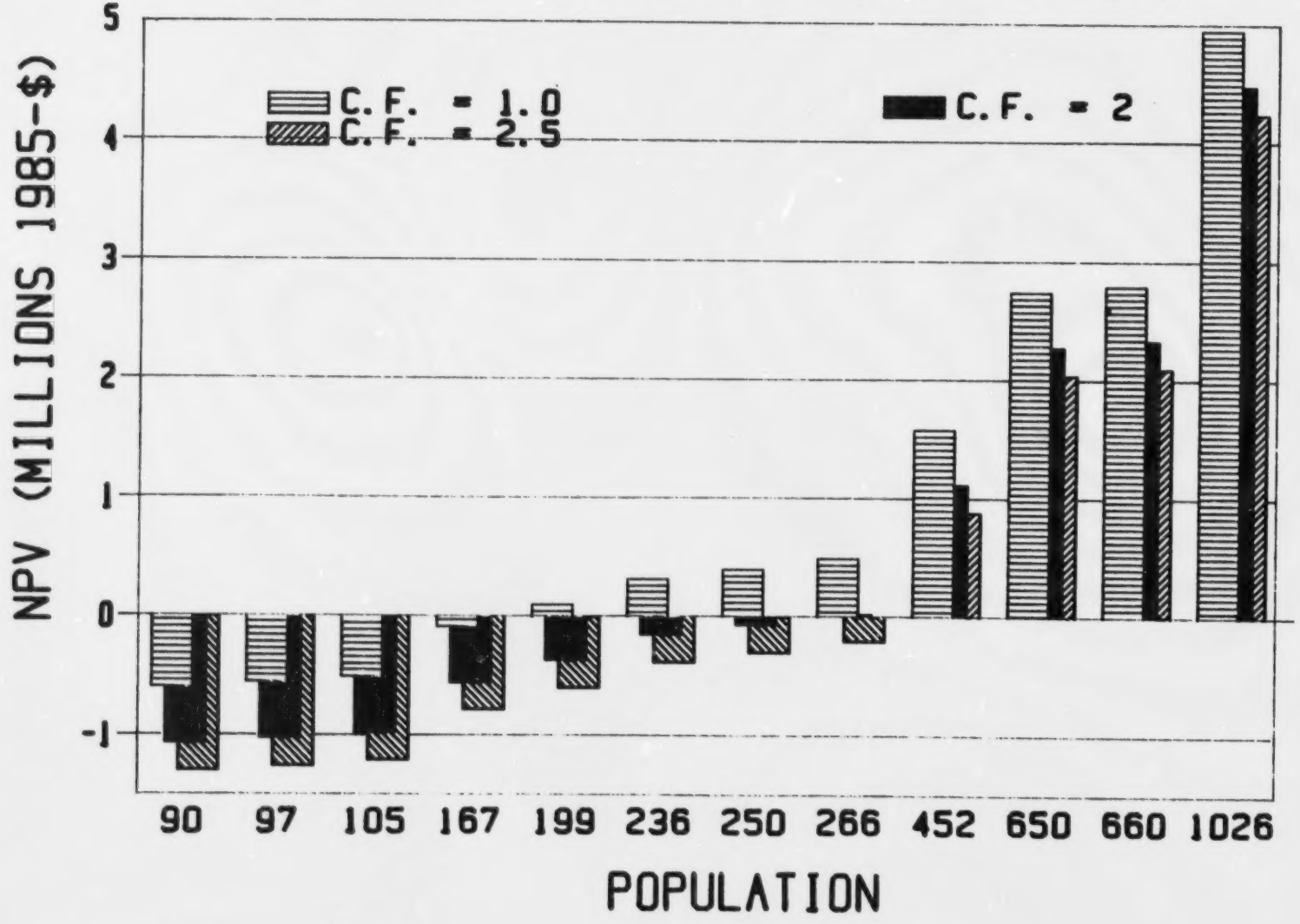
1. Medical evacuation portion of costs based on DHC-6 service

TABLE 5.6 RECOMMENDED AIRPORT DESIGN-SUMMARY OF INCREMENTAL FACTORED COSTS AND BENEFITS FOR MANITOBA REMOTE AIRPORTS (1.)

FACTOR = 2.5

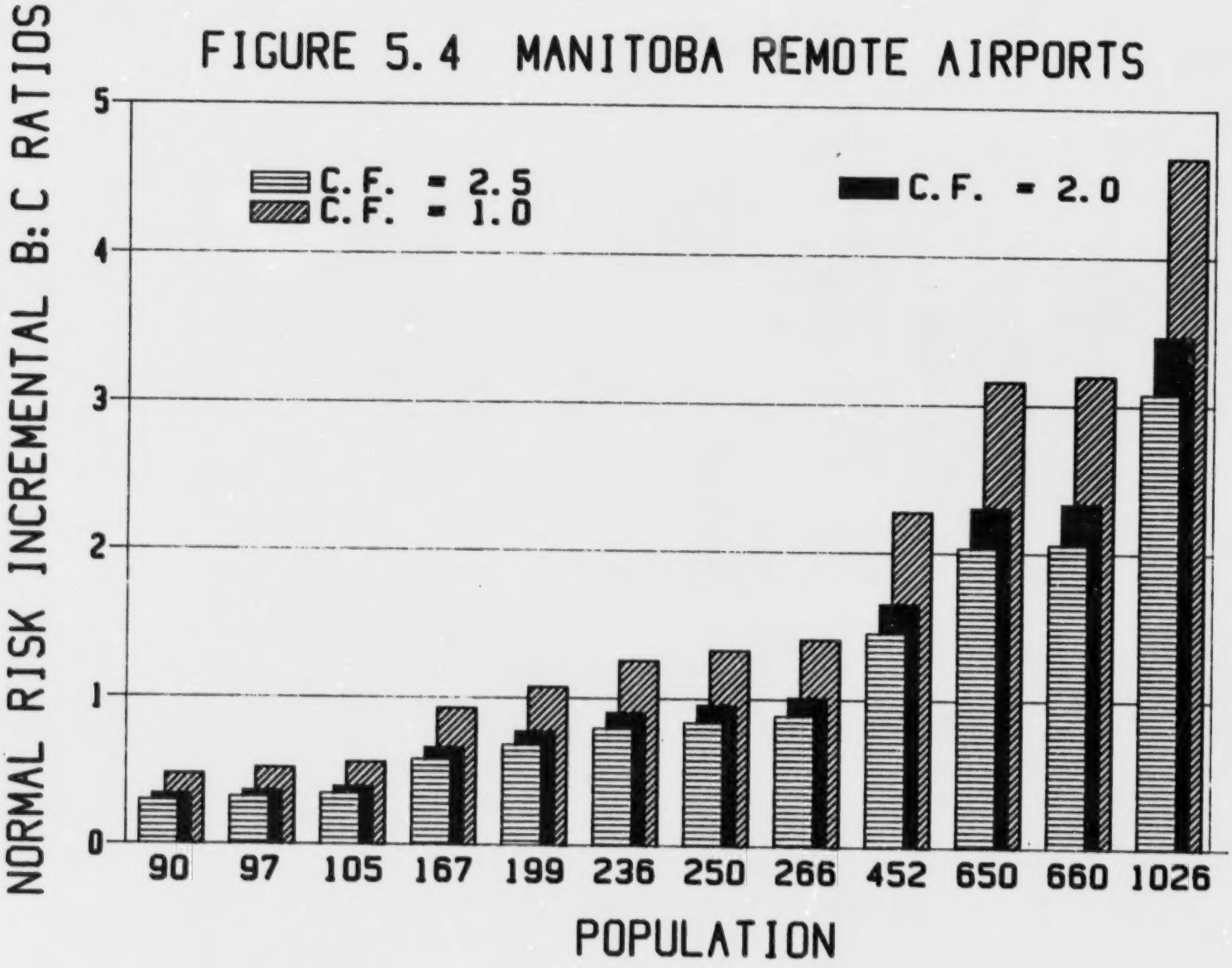
SOURCE: R.S.WALLACE & ASSOCIATES LTD.

FIGURE 5.3 MANITOBA REMOTE AIRPORTS



Source: R.S. Wallace & Associates Ltd.

FIGURE 5.4 MANITOBA REMOTE AIRPORTS



Source: R.S. Wallace & Associates Ltd.

A visual comparison of costs of airport construction is given in Figures 5.5, 5.6, and 5.7, "Recommended vs. TC Standard - 20-Year Constant Dollar Costs". The Figures show a comparison of costs broken down into four major categories:

(i) civil works - airside, landside (including all clearing, stumping, grubbing, grading, surfacing)
(ii) ATB and related utilities - water supply, sewage disposal, power generation, communications
(iii) lighting and navigational aids
(iv) mobile equipment - identical to that for recommended standard.

The effect of cost factors is seen to marginally widen the difference in calculated construction and equipment costs, between the recommended and TC-type airports. The recommended design is in the 50% range (of the TC-type airport) regardless of cost factor (1.0, 2.0 or 2.5).

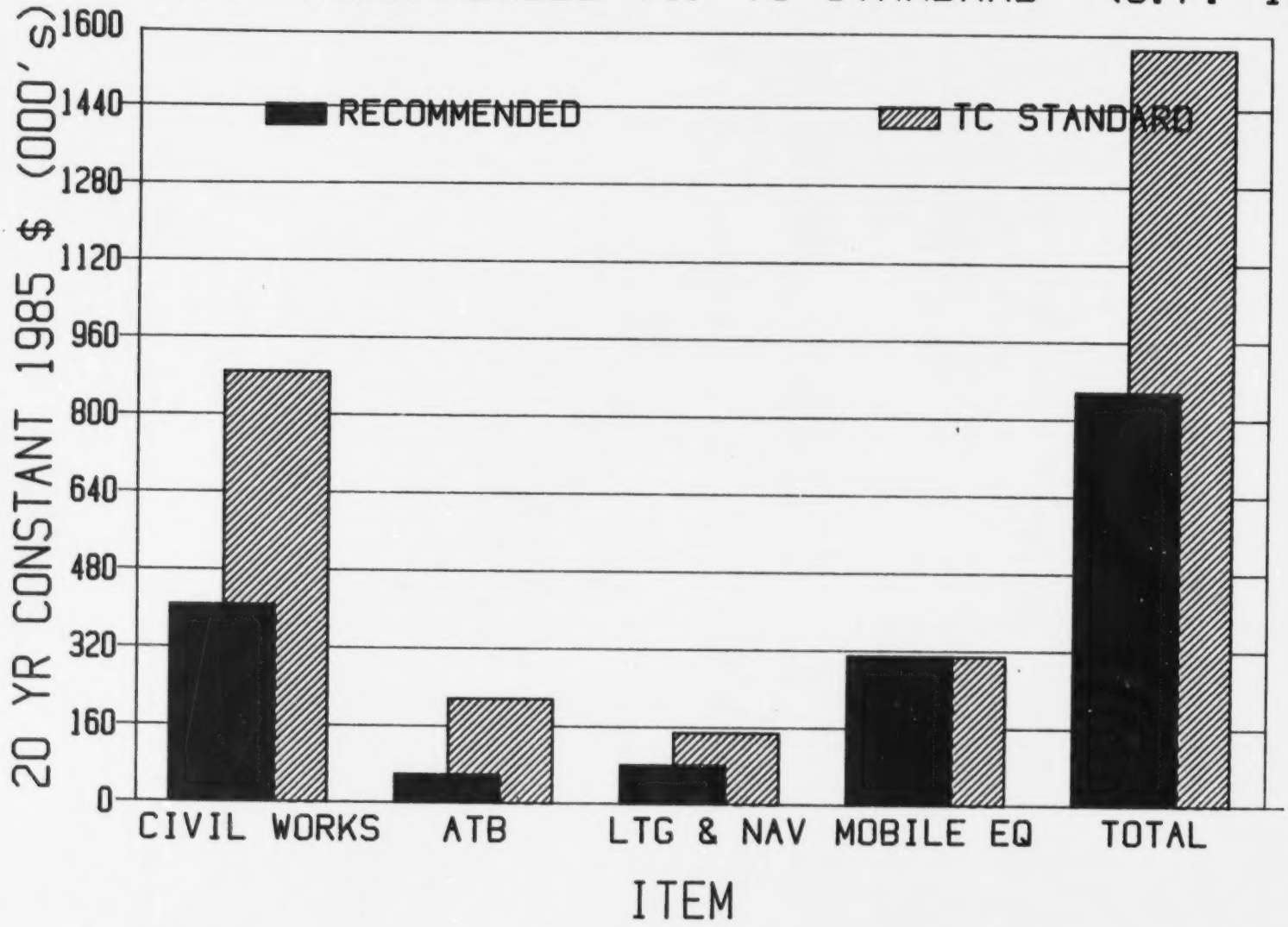
5.3.2 Nationwide Program

The effect that cost increase factors have on a nationwide program of 135 airports is to increase the overall costs by approximately 40% and 60% respectively. Total program costs for 135 airports over a 20-year period (recommended design, gravel runway) are calculated at $216,370,000 or $247,914,000 depending upon cost increase factor.

5.4 Conclusions

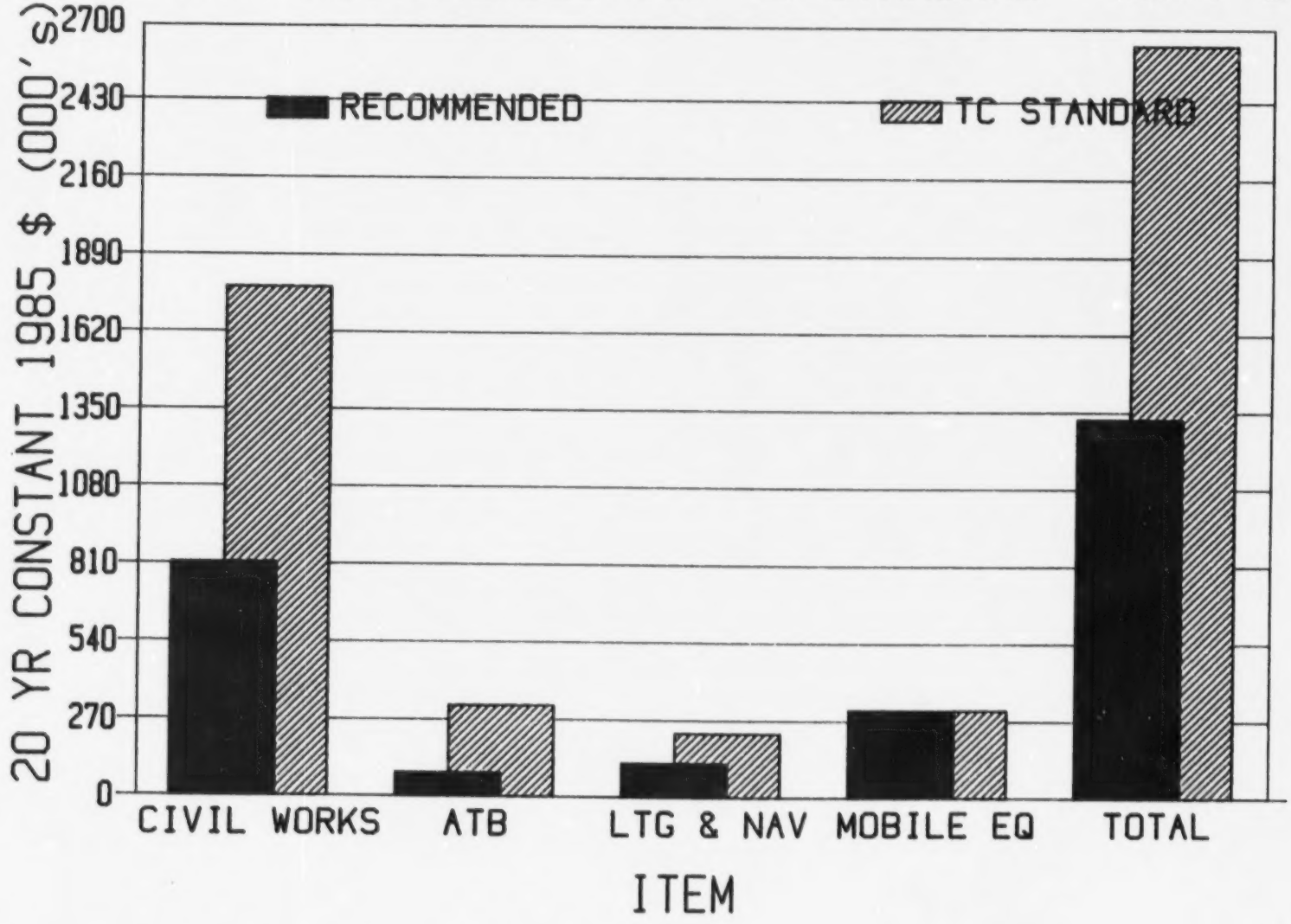
This Chapter has identified nationwide program costs (for construction, operation and maintenance of 135 new remote airports) of $200M to $250M over a 20-year period. This represents roughly 50 percent of the costs required for standard TC-type airports. The high b:c ratios calculated based on Manitoba data (1.8:1.0) indicate that provision of new, minimum-standard remote airports is worthy of further consideration.

FIG 5.5 RECOMMENDED VS. TC STANDARD (C.F.=1.0)



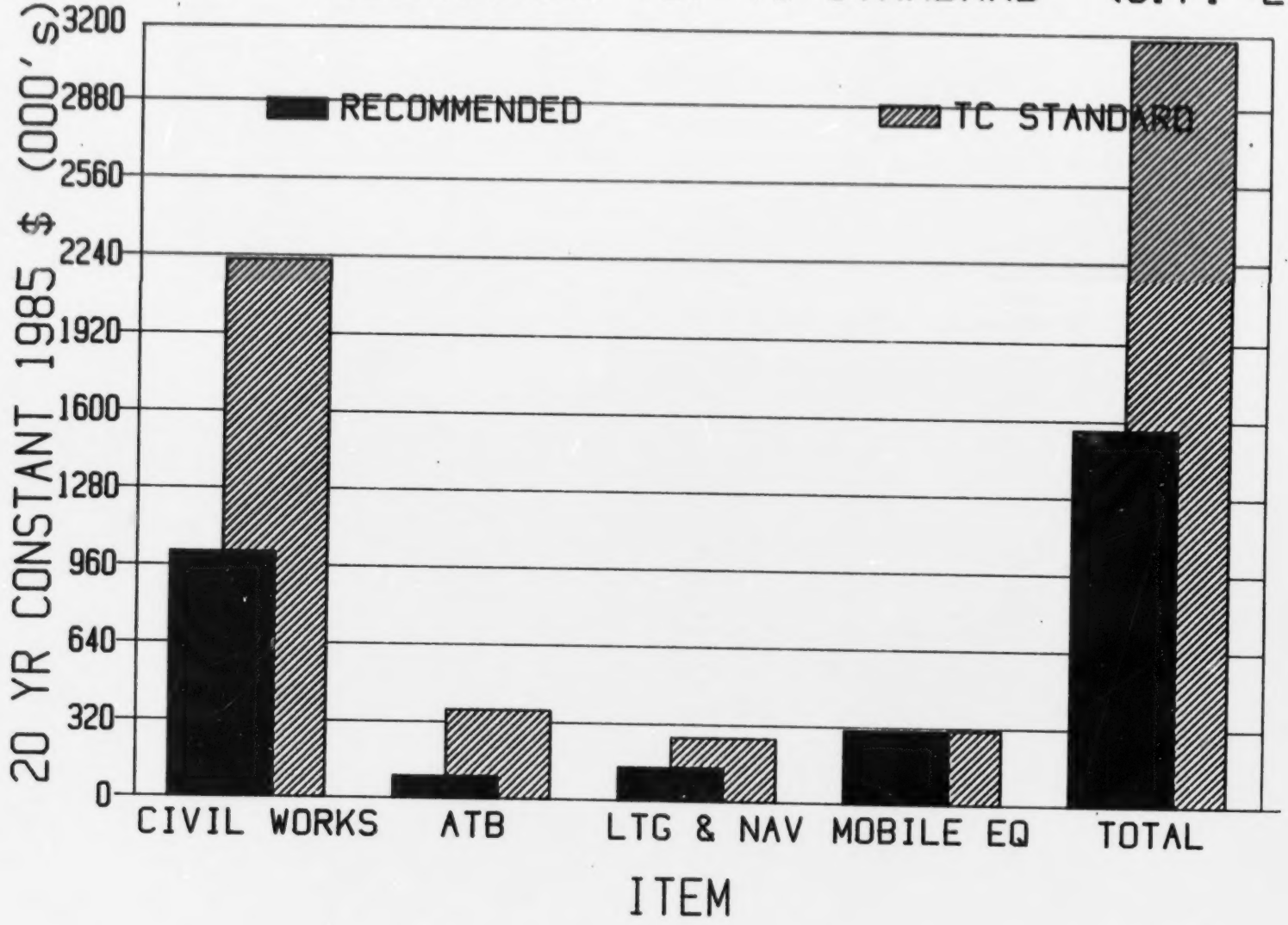
Source: R.S. Wallace & Associates Ltd.

FIG 5.6 RECOMMENDED VS. TC STANDARD (C.F.=2.0)



Source: R.S. Wallace & Associates Ltd.

FIG 5.7 RECOMMENDED VS. TC STANDARD (C.F.=2.5)



Source: R.S. Wallace & Associates Ltd.

6.0 IDENTIFICATION AND EVALUATION OF IMPEDIMENTS TO IMPLEMENTATION OF AIRPORT DESIGN GUIDELINES

Impediments to implementation fall into three categories: legal/procedural; financial; and jurisdictional.

6.1 Legal/Procedural Issues

The following legal/procedural issues have been identified for evaluation of their potential impedance of new airport design implementation:

(a) Transport Canada's airport licensing or certification regulations may preclude implementation. The Aeronautics Act empowers the Federal Minister of Transport, subject to approval of the Governor-in-Council, to ". . . make regulations to control and regulate air navigation over Canada . . . and may make regulations with respect to . . .

"(c) the licensing, inspection and regulation of all aerodromes and air-stations;

(d) the conditions under which aircraft may be used or operated;

(e) the conditions under which goods, mails and passengers may be transported in aircraft . . ."[14];

Regulations with respect to airport licensing and use are administered by the Canadian Air Transportation Administration's regional offices. CATA's regional inspectors examine and licence all airports to be used for commercial public air transport. The above regulations are set down in "Aerodrome Standards and Recommended Practices", TP 312. More sophisticated airport landing aids (not considered in this study) required for precision approaches would follow regulations contained in "Manual of Criteria for Instrument Approach Procedures" TP 308.

TP 312 is used as a standard guideline for the specific determination of required features to obtain a licence from TC, i.e. airport physical characteristics (runway length, width, etc.), obstacle limitations, lighting and markers/signs. Many of these design standards are directly related to the specifications requirements of the aircraft using the airport.

Private air strips not offering public commercial air services do not require a licence to operate.

(b) The Canadian Transport Commission's power to deny air carrier (up to Class 3) licenses on the basis of airport capability may preclude implementation. For commercial air carrier regulation, Part II of the Aeronautics Act empowers the Canadian Transport Commission to ". . make regulations

"(a) establishing the classification and form of licenses to be issued under this Part, . . .;

"(b) prescribing the terms and conditions to which licenses issued under this Part shall be subject; . . ."[15], p. 38) and further under Section 16[14]. "The Commission may issue to any person applying therefor a license to operate a commercial air service . . ."[16]

And further still under Section 16[18],

"Notwithstanding the issue of a license under subsection (14), no air carrier shall operate a commercial air service unless he holds a valid and subsisting certificate issued to him by the Minister certifying that the holder is adequately equipped and able to conduct a safe operation as an air carrier."(17);

(c) Provincial aeromedical transport programs may require at least twin-engined aircraft as Manitoba does(18), which would preclude certain low-cost airport design options available to single-engined aircraft. The recommended design will accommodate twin-engine aircraft.

6.2 Financial Issues

Several financial issues have been identified and are listed below:

(a) Airport funding from the various levels of government may be contingent on TC-approved design standards. For example, Economic Regional Development Agreement funding for airports requires Transport Canada sub-agreements review to ensure compatability with Transport Canada's airport standards(19).
Transport Canada's own grants and subsidies program for new municipal airport construction and municipal airport improvements requires review by TC regional staff for compliance with Transport Canada design standards.(20)

(b) A remote airport's revenue generating potential may be low relative to other airports thus introducing an impediment of poor cost recovery;

(c) Who pays for the airport vs. who benefits from the airport?; and

(d) Although unlikely, airport and aircraft insurance cost increases may be an impeding factor in implementation. Notwithstanding Transport Canada licensing of an airport, insurance underwriters evaluate the safety of design features for each airport. Depending on the degree of design risk introduced, the airport insurance rates might be "loaded" (increased) accordingly, e.g. turf runway, winter ski operations, obstacles, etc. However, this loading would not represent a major cost to the airport, e.g. a 20 to 50% loading on a typical $750 annual premium represents a cost penalty of only $50 to $375 per year. Aircraft insurance rates would likely not be affected, except where the airport is the home base for a commercial air service.(21)

6.3 Jurisdictional Issues

The following potential jurisdiction impediments have been identified:

(a) The Federal Government claims exclusive jurisdiction in aviation thus impeding independent airport design implementation where certain types of commercial operations will take place. As cited above under Section 6.1, the Aeronautics Act gives the Federal Minister of Transport jurisdiction in all matters connected with aeronautics. Hence, the ability of a provincial or local jurisdiction to act independantly in airport design can be absolutely constrained. In

practice, however, the Minister has exercised his jurisdictional power only for public airports offering commercial services.

(b) Overlapping departmental jursidications can impede implementation, e.g. environment department approval of airport construction site.

6.4 Evaluation of the Implementation Impediments to Recommended Airport Guidelines

6.4.1 Runway Length

The recommended runway length of 366 m (1200 ft) meets the aircraft takeoff length requirement to 15 m (50 ft) above the end of the runway. The aircraft analyzed in this study are those that would typically serve remote areas; i.e. non-performance aircraft such as the C-185 and the DHC-6 (Twin Otter).

The 1983 Draft Airport Operating Rules are being re-written in appropriate legal language for submission to Privy Council. These rules specify for non-performance aircraft (5,682 kg (12,500 lbs) and under max. T/O weight) that "the all engine distance to 15 m (50 ft) must be flown over the runway."(22)

On the recommended 366 m (1200 ft) runway, the non-STOL DHC-6 would be reduced in its payload capacity by 680 kg (1500 lbs) at 22°C and 305 m (1000 ft) elevation. At lower temperatures and elevations, this weight penalty would be lessened.

6.4.2 Runway Width

The recommendation of a 15 m runway width meets TC standards for Code type A using the C-185 aircraft.(11) While the DHC-6's outer main gear wheel span of 3.81 m meets the Code A requirements, the 19.81 m wing span exceeds the 15 m standard for wing span.

It is felt that this is not critical to aircraft safety, given the provision of load bearing shoulders and the low probability of run-offs, i.e. one runoff every 2,600 years for a typical remote community. (See Technical Memorandum, Chapter 3.0).

The cost saving, reduced strength shoulder pavement for the center section of the runway recognizes that landings typically occur near the runway threshold, on the full strength pavement area. This "reduced strength" is still sufficient to safely support an aircraft landing or takeoff.

6.4.3 NDB

Since the airport operating scenario considered here is day/night VMC, there would be no NDB requirements.(23) Hence, the low-cost NDB recommended to facilitate locating airports in remote areas should encounter no impediments to implementation.

6.5 Conclusions

The principal impediment to implementation of the recommended guidelines as standards for remote airports is their acceptability to Transport Canada. TC has clear legal and jurisdictional authority to specify the design of public airports. The Federal Government has additional persuasive powers through its purse, i.e. various airport subsidy programs are conditional upon the use of TC accepted airport design standards.

Based on discussions with those TC officials responsible for revisions to TP 312, it is anticipated that many of the recommended design changes may be acceptable.

The second major potential impediment to implementation would be availability of capital funds. This impediment factor would vary from province to province depending on provincial spending priorities. Notwithstanding the high b:c ratios for remote airports, any capital program would be subject to budget constraints.

On the distribution question of who pays vs. who benefits, the analysis contains benefits that the airport users could never pay for directly. Hence, society (each province) must make its own judgement with regard to the gain to the society as a whole from increased access for a remote sector of its citizens.

7.0 IMPLEMENTATION PROGRAM

7.1 Manitoba Situation

Assuming that new airports are to be constructed at the 12 Manitoba sites identified in the study, a hypothetical implementation schedule has been drawn up. This permits a rapid assessment of costs to be incurred for a given year. Costs considered in the implementation schedule are:

(i) construction (initial site development, including all civil works, ATB and utilities)
(ii) mobile equipment (initial purchase and periodic replacement)
(iii) O&M
(iv) periodic resurfacing

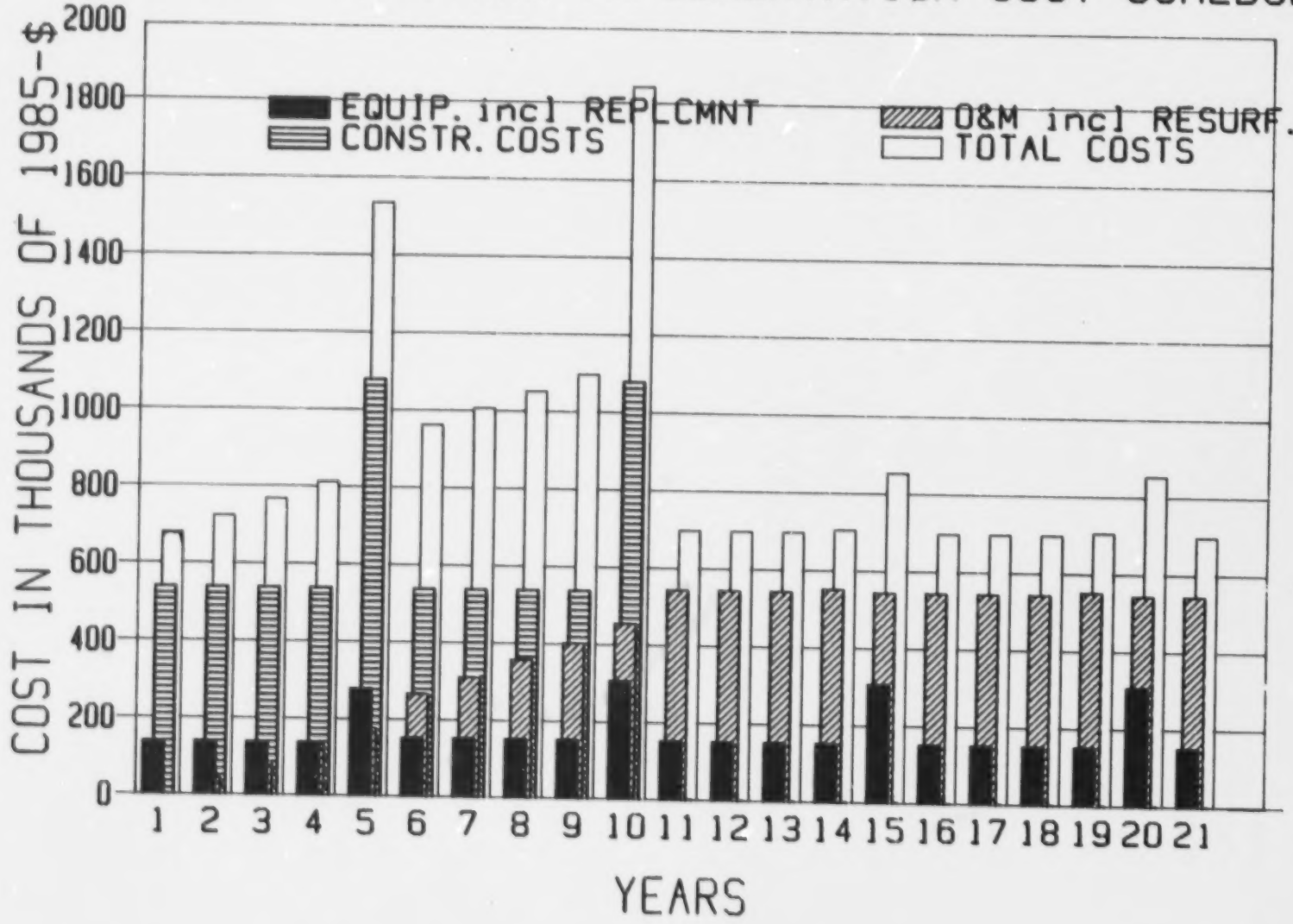
The schedule is calculated over a 20-year period. Construction starts are annual, beginning in year 1. Arbitrarily, two construction starts are allocated to each of years 5 and 10, thus allowing construction of all 12 airports within a 10-year period. The implementation cost schedule is presented in Appendix D, "Manitoba Implementation Cost Schedule". Total cost for the above items for the 20-year period is $18,592,400 (based on Winnipeg prices). Annual capital costs range from a low of $682,175 to a peak of $1,852,300 in year 10. Note that the 20-year period was chosen only as a representative planning horizon; virtually none of the 12 airports will have exceeded their useful lives at the end of this period. The cost data are shown graphically in Figure 7.1, "Manitoba Implementation Cost Schedule".

7.2 Nationwide Program

Based on the figure generated for the 20-year operation of the hypothetical Manitoba program, a 20-year nationwide program would cost (construction, mobile equipment, O&M, periodic resurfacing) in the order of $209M. This figure does not include aircraft operating or accident costs.

It would be most equitable for each province to develop its own priorization policy. In all likelihood the communities with the highest b:c ratios (those with largest populations) would receive higher priorities.

FIG 7.1 MANITOBA IMPLEMENTATION COST SCHEDULE



Source: R.S. Wallace & Associates Ltd.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Conclusions and recommendations (when appropriate) are reported simultaneously, for ease of reference.

Conclusions	Recommendations
1. In Manitoba, 12 remote communities were identified from a total in the northern portion of the province of 150. These 12 communities have a combined population of 4,200 and range in size from 90 to 1026 persons. Their total population represents roughly 6% of the total in the northern region. These findings were used to generate a figure of 135 remote communities requiring new airports nationwide. (A remote community is defined as any permanent population grouping larger than 50 persons not having all-year-around access to emergency service hospitals within a four hour round trip time, by any mode.)	Consideration be given to constructing low cost, minimum standards airports at these 135 sites over a ten year period.
2. The persons in these communities would benefit from construction of airports operating all year round in their communities. The major benefits would be in the areas of health care and emergency services. Secondary benefits would accrue in economic and rural services sectors.	
3. The DHC-6-300 aircraft was selected as the design aircraft used in the design of the airport facilities. It was chosen primarily because of its twin turboprop engines which are often preferred for an air evacuation vehicle. Also it required the minimum airport facilities because of its STOL characteristics. This is important in minimizing costs. Further reasons for its selection were its cabin size which provides ample room for several patients and medical attendants. Its lack of pressurization, while a disadvantage to critical patients was not considered to be serious for the altitudes at which it normally operates.	The airfield geometrics and pavement design criteria should be based on serving the DHC-6-300 aircraft. Extensive visual navigational landing aids, complimented by a low power NDB should be installed at each site to facilitate location under marginal visibility conditions (particularly prevalent in winter).

Conclusions	Recommendations
4. Many single engine and additional light twin engined aircraft will be able to utilize these runways. Some however will have to do so under reduced operating weights when elevated temperatures occur. The restrictions due to high ambient temperatures are expected to be minimal because these temperatures occur infrequently.	
5. It was considered to be non-cost effective to design the airports for IMC. Further, operating and maintenance skills might not be available when needed.	The airports should be operated under day/night VMC for reasons of economy, and to reduce the need for skilled airport attendants. The merits of various IMC capabilities should be investigated at particular sites to determine those situations where increased availability over that for VMC could be justified.
6. Under the low anticipated annual hours of utilization and the additional costs of added runway length the Citation II aircraft was not selected as the design aircraft for Manitoba. However, for the Manitoba situation or in those other provinces where such an aircraft is already used for air ambulance work, by costing the additional hours of use due to serving the remote sites as marginal costs it may prove cost effective to design for this aircraft. The level of service offered would be increased, the number of emergency hospitals designated for use reduced to one for most provinces, and accessibility by larger aircraft to the remote communities improved.	Each province currently utilizing a Citation II type aircraft for provision of emergency medical services should re-evaluate the cost-effectiveness of basing airport design on this aircraft as opposed to the DHC-6.
7. Seven alternative pavement types were described. They are suitable for use under various conditions. On a comparative basis this cost ranges from a low of \$3-4 to a high of \$71 per m^2 of surface. Each one may prove to be most cost effective at particular sites.	Consideration be given to using some of the more exotic pavement sections in situations where they are judged to be cost effective. For example if gravel or crushed rock are not economically available but sand is, then Portland or Asphaltic Cement sand pavements should be considered.
8. Several possible changes to the current TP312E have been investigated to reduce costs without reducing service or safety below acceptable levels. In other areas affecting costs, economies can be realized; i.e. use of a trailer as a lower cost air terminal building is feasible and indeed is sometimes used successfully.	Consideration be given to relaxing the present standards for these remote site conditions to permit construction of airports at acceptable costs at additional small communities.

Conclusions	Recommendations
9. Research failed to identify needed information on three critical questions. Answers are needed before making further design reductions, i.e.: How rough is too rough, How short is too short, and How narrow is too narrow for the runway? The narrowness question was analyzed. There is some evidence that 15 m (50 ft.) is wider than that actually required. Further data is needed before additional width reductions could be made.	A program be undertaken to develop design information in each of these three areas. The first area to investigate is that of pavement width requirements under all weather conditions.
10. The reduced design for airfield pavements as compared with the typical equivalent design for remote communities offers a cost reduction of about 170 percent. Using standardized costs based on Winnipeg prices the comparison is $270,000 vs. $712,000. When applied to the estimated potential 135 sites in the 10 provinces this represents a capital savings of $59.7 million. Additional reductions in cost are available in the other airport components such as access, terminal, etc.	Serious consideration should be given to developing design standards for lower cost airports where traffic does not warrant construction of more costly facilities.
11. On a quantifiable costs and benefits basis, and using Winnipeg prices, the break-even community size is 170 persons for an airport built to the suggested design for a DHC-6 design aircraft. The community size rises to 220 persons for break-even using the Citation II as the design aircraft. There are non-quantifiable benefits, not included in the above analysis that if taken into consideration would decrease the break-even community size.	Consideration should be given to construction of reduced cost airports at 7 to 9 of the Manitoba sites.

Conclusions

12. Applying a location cost inflation factor of 2.0 over Winnipeg for northern construction, the break-even community size for the Twin Otter design increases to 260 (5 communities).

13. In the 10 provinces there are 135 candidate remote communites meeting the study criteria. None are identified in Nova Scotia, New Brunswick or Prince Edward Island.

    There are a total of 1,694 communities in the remote regions of the remaining provinces. About 8% of these communities are not adequately served.

14. Depending upon the eligibility criteria used the number of candidate communities in the provinces will vary.

    Considering all 135 sites as being eligible, the costs are $153.3 million for airports, $5.4 million for increased aircraft accidents and $5.2 million for incremental increased aircraft operating costs due to all year round operations on wheels. (Aircraft on floats or skis have higher operating costs than those on wheels but operate for 10 out of 12 months each year. Offsetting these costs are projected incremental benefits of some $295M - (1985-$).

15. A comparison of an airport's 20-yr 1985 dollar component costs for the proposed versus the conventional design are as follows:

	Conventional	Proposed	% Red'n.
Civil Works	$893,000	$409,000	54
ATB	$219,000	$ 60,00	73
Ltg & Nav.Aids	$150,000	$ 81,000	46
Mobile Eqpt.	$310,000	$310,000	0
Total	$1,572,000	$860,000	45

Recommendations

A more detailed analysis should be made of actual emergency service response times for Nova Scotia, New Brunswick and the Gaspe Bay area of Quebec.

Many of the 135 remote candidate communities should receive low cost airports.

Aircraft/passenger accident/fatality/cost analysis for small sites could be improved upon. In light of scarce statistical data, a Monte Carlo-type simulation could be used to estimate costs and benefits.

Conclusions	Recommendations
16. On a 135 site nation wide system, applying to the affected components a cost factor of 2.0 increases the total costs by 40% and use of 2.5 increases the costs by 60%.	
17. Total program costs (including construction, aircraft/airport O&M, aircraft accident) for a nation wide program of 135 airports over a 20-year period (gravel surface, DHC-6 design, cost factor = 1.0) are $164M. The average b:c ratio is 1.8 for incremental benefits of $295M.	
18. The adoption of the recommended design revisions is dependent upon the ability of Transport Canada to adopt them into their TP312 standards.	Consideration be given to adoption of some or all of the design changes into TP312.
19. Financing of the program will likely be a joint Federal/Provincial shared cost program. When extended over ten years the annual cost is rather modest with the identified benefits exceeding the costs.	Consideration be given to funding under existing provincial/federal/local programs. In some situations the local share could be paid by Indian and Northern Affairs.
20. The benefits of the program often do not accrue to the government departments paying for the program. Reductions in health care and hospital costs accrue to health care organizations whereas most of the costs are paid by transportation organizations.	No attempt should be made to allocate costs to the benefitters on an explicit basis.
21. Scheduled air operations are approximately 12.5 times as safe as auto travel. The fatal person-accidents per million passenger kilometers for air are 0.00088. For road the rate is 0.011.*	Consideration should be given to reallocating funds currently spent on air safety to improving road safety. In addition the remote airports constructed to a reduced standard will provide more safety to more persons than will allocating equivalent funds to fewer, higher cost airports. It would appear this change would be cost effective.

*Total person accident rates for air are $0.011/10^6$ pass.-km, and for road $3.692/10^6$ pass.-km.

Conclusions	Recommendations
22. It was beyond the scope of this study to include an analysis of helicopter operations.	Evaluation of twin-engine turbine powered helicopter service should be considered as an alternative to fixed wing ambulance service, prior to any province's undertaking a new airport construction program.
23. This study has identified potential new airport design variations. These include: reduced strength runway sections; 10% shoulder drain slope in fill areas, somewhat unconventional pavement sections, and use of low cost stone filled drains where required.	The effect that these design variants have on aircraft operations should be more fully investigated. For example, the effects of assymetric wheel drag during aircraft landing operations (one wheel on full-strength section, one wheel on reduced-strength section) could cause skewing if the reduced strength section is much weaker.

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APPENDIX A

Terms of Reference

TRANSPORTATION DEVELOPMENT CENTRE

WORK STATEMENT

RESEARCH ON STANDARDS FOR REMOTE AIRPORTS

1 February 1984

1. INTRODUCTION

Equitable access to transportation is a Transport Canada objective and is particularly difficult to attain for isolated communities. In the Yukon and Northwest Territories where the Federal Government has jurisdiction, the Arctic Airports Program has been developed to meet this objective. There is no similar program encompassing all other remote communities in the provinces. Although this is a provincial responsibility, the air mode, which is usually the most economic for such service, falls under federal government responsibility.

There are two problems inhibiting airport development for remote communities: - cost and safety, both of which relate directly to the standards in effect for the design and construction of airports. Many airports in remote areas do not meet the existing standards, thus there is a need to undertake research which can clarify the relationship between airport design, along with the cost implications and levels of safety, and what such relations indicate for accessibility and service reliability.

The major part of the research in this study will focus on two areas: alternative methods of airport planning, construction and maintenance (suitable material, drainage, perma-frost) at reduced costs and the second area under investigation will be safety involving quantitative research on the level of risk associated with various levels of standards.

2. OVERALL OBJECTIVE

To improve the accessibility to more isolated communities at an acceptable level of safety and at minimal capital and operating/maintenance costs.

3. PROJECT OBJECTIVE

To develop guidelines for the location, planning design and construction of airports for isolated communities to minimize total system costs while maintaining a specific level of safety.

.../2

4. DETAILED STATEMENT OF WORK

The work constituting this project shall include the following elements and shall be consistent with the proposal entitled: Provision of Airports to Isolated Communities, dated October 1983.

4.1 Phase 1 Mini Analysis of Research into Remote Airports

4.1.1 Develop a detailed work plan, activity schedule and cash flow projection within two weeks of effective commencement date.

4.1.2 Definition of scope of study

4.1.3 Estimate of program benefits by province

4.1.4 Estimate of program costs by province

4.1.5 Scope and merit of implementation

4.1.6 Report providing cost-benefit estimates and detailed work plan for Phases 2, 3 and 4

4.2 Phase 2 Airport System Alternatives

Generate alternative approaches applied to various parts of the airport's systems (landing surface, maintenance, equipment etc.). Alternatives will be measured against established criteria and the more promising ones will be subjected to detailed engineering analysis to evaluate feasibility and costs.

4.3 Phase 3 Safety Analysis

In this phase, risk, relative to airport parameters (e.g. runway length, surface, condition, aircraft performance, pilot capabilities), will be quantitatively analysed.

4.4 Phase 4 Determination of Standards and Guidelines

Outputs of Tasks 2 and 3 will be used in a cost-benefit analysis to determine appropriate airport system standards and planning guidelines such that safety will be maintained within a quantified level of risk.

4.5 Provide reports as described in Section 9 "Reporting Requirements.

5. ROLE OF OTHER PARTIES

Agreement has been reached with Manitoba Department of Highways and Transportation to support this study in the event that airports for isolated communities in Manitoba are reviewed as samples for the study; this agreement has been identified in letters from Dr. J. Rea, Director of the Transportation Division.

6. SPECIAL INSTRUCTIONS

Upon completion of Phase 1 the TDC Project Officer will review the findings. No further work on the subsequent phases shall be started without the written authorization of the Project Officer.

In order to accommodate this review period a minimum delay of three weeks should be scheduled.

7. PROJECT ADMINISTRATION

The Executive Director, Transportation Development Centre (TDC) will appoint a Project Officer to manage the project on behalf of TDC. A progress review committee may be convened at the invitation of TDC to counsel the Project Officer, to monitor progress and comment as necessary on the envisaged work.

Contract administration will be provided by Supply and Services Canada (DSS).

8. PROJECT CONTROL

The project shall be controlled by a CPM, PERT, SPEC or equivalent responsibility assignment and schedule method. Budgets for each project element should be prepared at the start of the project and monitored regularly to ensure resources available are compatible with estimates to complete the work.

9. REPORTING REQUIREMENTS

9.1 Progress Reports

To facilitate the management of the project, a minimum of five (5) copies of the progress reports shall be submitted on a monthly basis to the TDC Project Officer with a copy to the DSS Science Procurement Manager. These reports shall be short and concise, not exceeding the typewritten pages.

The format of the progress report should be as follows:

9.1.1 A list of all persons actively working on the project and their functions.

.../4

9.1.2 Current status of work, containing an estimate of the percentage of work completed, the percentage of time elapsed, and a clear statement as to whether the project will or will not be completed within the established schedule and the agreed financial limitation.

9.1.3 Work accomplished since the period last reported.

9.1.4 Problem areas, if any.

9.1.5 Work to be addressed and expected to be achieved in the coming months.

9.1.6 Any action required on the part of TDC or Manitoba Department of Highways and Transportation.

9.1.7 Contact made with outside agencies or companies, or major visits planned in connection with the project.

9.1.8 Other important information deemed to be appropriate.

9.2 Publication Standards

9.2.1 All reports with the exception of progress reports shall be prepared in accordance with the "TDC Publication Standards for Contractors (TP 929)" the latest issue to be provided to the contractor by the DSS Science Procurement Manager at the contract negotiation stage.

9.2.2 A summary report shall be prepared in both official languages for all final reports whose main content, excluding appendices, exceeds 25 pages. If unable to provide a summary report in the other official language, TDC shall make alternative arrangements.

9.2.3 A bilingual Report Documentation Form shall be included in every report as specified in TP 929, with the page format supplied by TDC.

9.2.4 Covers for the summary report shall be provided by the TDC Project Officer as soon as the draft of the report has been approved.

9.2.5 S.I. metric units shall be used in all reports.

9.3 Delivery Schedule of Reports

9.3.1 Reports shall be submitted as follows:

a) 5 copies each of draft summary reports and Report Documentation Form (in both official languages) and draft final report in contractor's working language 10 months after contract signing date.

b) TDC comments on draft reports to contractor 1 month after receipt.

c) 100 copies of summary reports (70 in English, 30 in French) 1 month after receipt of TDC's comments.

d) 25 copies of final reports (in contractor's working language) 1 month after receipt of TDC's comments.

9.3.2 In addition to the required number of printed copies of final versions of reports, the contractor shall deliver one master copy suitable for reproduction.

9.3.3 For control purposes, all reports, except progress reports, shall be delivered to:

Supervisor, Records Office
Transportation Development Centre
1000 Sherbrooke Street West
Suite 2421
Montreal, Quebec H3A 2R3

The Records Office will ensure that copies are forwarded to the Project Officer.

APPENDIX B

Candidate Remote Communities

TABLE B-1
CANDIDATE REMOTE COMMUNITIES
(POPULATION > 50, LATITUDE > 51 & NO ADEQUATE HOSPITAL FACILITIES)

Community Name	Latitude (DEG,MIN)	Longitude (DEG,MIN)	1981 Pop'n	Airport Runway Length (m)	Airport Runway Surface Type
Barrows	5249	10125	199		
Bellsite	5234	10104	83		
Berens River 13	5221	9701	919	760	gr/clay
Big Eddy	5351	10117	134		
Bloodvein River 12	5146	9642	413	910	gr/clay
Brochet 197	5753	10140	557	900	gr
Camperville	5159	10009	586		
Clearwater Lake	5422	10109	81		
Conlin Lake	5505	9805	50		
Cormorant	5413	10038	445		
Cowan	5204	10039	70		
Cranberry Portage	5435	10122	948		
Crane River 51	5131	9917	491		
Cross Lake 19,19A	5437	9747	2077	910	gr
Dauphin River 48A	5157	9803	70		
Dawson Bay 65A	5245	10041	266		
Duck Bay	5209	10010	594		
Durban	5156	10127	75		
Easterville	5306	9949	589	910	gr
Ebb and Flow 52	5103	9900	502		
Eddystone	5103	9912	80		
Ethelbert	5132	10023	1241		
Fairford 50	5136	9834	620		
Fisher Branch	5105	9738	511	250	gs
Fisher River 44	5126	9722	706		
Forest Grove Tr. Ct.	5411	10122	73		
Fork River	5130	10003	80		
Garden Hill	5352	9441	1365		
God's Lake 23	5433	9428	440	700	gr/clay
God's River	5450	9517	96	1220	clay
Grand Rapids 33	5310	9916	903	1280	gr
Grandville Lake	5722	9808	137		
Gypsumville	5146	9839	92	850	gr
Hillridge	5103	9912	201		
Hillsburg	5117	10106	671		
Hollow Water 10	5110	9617	461		
Hybord	5310	9916	74		
Ilford	5604	9537	149	910	sand/gr
Inglis	5054	10115	209		
Island Lake 22,22A	5351	9439	2664	1000	gr/clay
Island Lake 22,22A	5351	9455	2664	1220	gr
Jackhead 43	5154	9718	183		
Kenville	5201	10123	141		

TABLE B-1 CONTINUED
CANDIDATE REMOTE COMMUNITIES
(POPULATION > 50, LATITUDE > 51 & NO ADEQUATE HOSPITAL FACILITIES)

Community Name	Latitude (DEG,MIN)	Longitude (DEG,MIN)	1981 Pop'n	Airport Runway Length (m)	Airport Runway Surface Type
Lac Brochet	5836	10135	231		
Lawrence	5121	9938	866		
Little Gr Rapids 14	5203	9528	559	910	clay
Little Sask 48	5141	9834	190		
Mafeking	5242	10106	260		
Manigotagan	5107	9618	216		
Matheson Island	5144	9655	118	760	gr/clay
Minitonas	5205	10101	1997		
Moose Lake 31A	5342	10018	868	910	gr
Mossey River	5135	10000	1061		
Mountain (North)	5231	10058	1541		
Mountain (South)	5155	10027	1080		
National Mills	5249	10125	56		
Nelson House 170	5548	9853	761		
Ochre River	5103	9944	1394		
Oxford House 24	5457	9517	1110	910	clay
Park (North)	5131	10123	492		
Paunigassi	5152	9533	296		
Peguis 1B	5117	9733	1305		
Pelican Rapids	5244	10041	178		
Pikwitonei	5536	9709	175	670	gr
Pine Creek 66A	5205	10012	300		
Pine Dock	5125	9705	81		
Pine River	5147	10032	314		
Poplar River 16	5300	9717	447	700	gr/clay
Profits Subdivision	5350	10107	64		
Pukatawagan 198	5545	10118	449	880	gr
Red Sucker Lake	5409	9335	312	910	gr/clay
Riverton	5100	9700	657	760	gs
Rorketon	5124	9935	229		
S. Indian Lake	5647	9857	770	790	clay
San Clara	5131	10126	136		
Shamattawa 1	5552	9206	519	1270	sand/gr
Shell River	5117	10123	1161		
Sherridon	5507	10107	138		
Sifton	5121	10010	210		
Siglunes	5104	9630	1596		
Split Lake 171	5615	9606	985		
St. Rose du Lac	5104	9931	1090		
Ste. Theresa Point	5349	9452	1005		
Steep Rock	5131	9837	86		

TABLE B-1 CONTINUED
CANDIDATE REMOTE COMMUNITIES
(POPULATION > 50, LATITUDE > 51 & NO ADEQUATE HOSPITAL FACILITIES)

				Airport Runway	
Community Name	Latitude	Longitude	1981 Pop'n	Length (m)	Surface Type
	(DEG,MIN)	(DEG,MIN)			
Swan Lake 65C	5231	10051	77		
Tadoule Lake	5751	9810	250		
The Narrows 49	5145	9825	452		
Thicket Portage	5519	9741	195	700	gr/clay
Umpherville Settlem	5350	10114	256		
Valley River 63A	5114	10057	231		
Valleyview Tr Ct	5343	10114	332		
Wabowden	5454	9838	655		
Wanless	5411	10122	193		
Wassagomach	5352	9441	439		
Waterhen 45	5157	9936	291		
York Landing	5529	9657	229	910	gr

APPENDIX C
Cost:Benefit Calculations - Manitoba Communities

Table C1
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS
FOR PANNIGASI
Population 266

A/C: DHC-6
Temp: 22 C
Elev: 1000 ft
GTOW: 10000 lbs
(non-instrument runway) CAR-3

a)

CIVIL WORKS	PAVEMENT TYPE (P)						
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$247,305.14	$242,893.97	$252,443.41	$256,375.67	$336,752.09	$510,006.44	$276,036.97
Subtotals	$400,942.64	$392,868.97	$420,730.91	$431,988.17	$655,202.09	$1,158,081.44	$488,274.47

(strip length = 426 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 366 m.); gravel= 372 ; turf= 377

Civil works Subtotals:	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$269,492.64	$264,218.97	$278,080.91	$283,738.17	$397,752.09	$648,631.44	$312,024.47

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$16,633.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$81,233.00

Grand Totals	$682,175.64	$674,101.97	$701,963.91	$713,221.17	$936,435.09	$1,439,314.44	$769,507.47

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$7,950.84	$8,037.16	$11,796.78	$11,796.78	$7,950.84	$0.00	$11,796.78
	PV	$3,065.37	$3,098.65	$1,656.22	$1,656.22	$3,065.37	$0.00	$1,656.22
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Increental A/C Energ. Serv. DOC	Annual	$195.67	$195.67	$192.78	$192.78	$195.67	$192.78	$192.78
	PV	$1,665.87	$1,665.87	$1,641.25	$1,641.25	$1,665.87	$1,641.25	$1,641.25
h) Increental Reg. Pass. Serv. DOC (60% LF)	Annual	$3,318.29	$3,318.29	$3,269.25	$3,269.25	$3,318.29	$3,269.25	$3,269.25
	PV	$28,250.58	$28,250.58	$27,833.09	$27,833.09	$28,250.58	$27,833.09	$27,833.09
i) Increental A/C Accident Costs								
Risk Level 0	Annual	$4,353.63	$4,353.63	$4,353.63	$4,353.63	$4,353.63	$4,353.63	$4,353.63
	PV	$37,065.06	$37,065.06	$37,065.06	$37,065.06	$37,065.06	$37,065.06	$37,065.06
Risk Level 1 (1.5X)	Annual	$5,115.51	$5,115.51	$5,115.51	$5,115.51	$5,115.51	$5,115.51	$5,115.51
	PV	$43,551.41	$43,551.41	$43,551.41	$43,551.41	$43,551.41	$43,551.41	$43,551.41
Risk Level 2 (2X)	Annual	$5,877.40	$5,877.40	$5,877.40	$5,877.40	$5,877.40	$5,877.40	$5,877.40
	PV	$50,037.83	$50,037.83	$50,037.83	$50,037.83	$50,037.83	$50,037.83	$50,037.83
Risk Level 3 (3X)	Annual	$7,401.17	$7,401.17	$7,401.17	$7,401.17	$7,401.17	$7,401.17	$7,401.17
	PV	$63,010.60	$63,010.60	$63,010.60	$63,010.60	$63,010.60	$63,010.60	$63,010.60

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 266)								
a) Emergency Health Care								
-lives saved (0.49/yr)	Annual	$117,005.95	$117,005.95	$117,005.95	$117,005.95	$117,005.95	$117,005.95	$117,005.95
	PV	$996,141.86	$996,141.86	$996,141.86	$996,141.86	$996,141.86	$996,141.86	$996,141.86
-permanent disabilities	Annual	$45,420.03	$45,420.03	$45,420.03	$45,420.03	$45,420.03	$45,420.03	$45,420.03
prevented (.99/yr)	PV	$386,687.97	$386,687.97	$386,687.97	$386,687.97	$386,687.97	$386,687.97	$386,687.97
-temp disability-lost	Annual	$215.14	$215.14	$215.14	$215.14	$215.14	$215.14	$215.14
work days saved (15.43/yr)	PV	$1,831.62	$1,831.62	$1,831.62	$1,831.62	$1,831.62	$1,831.62	$1,831.62
b) Air Service User Time	Annual	$36,382.60	$36,382.60	$36,382.60	$36,382.60	$36,382.60	$36,382.60	$36,382.60
Savings (3,678 hrs/yr)	PV	$309,746.90	$309,746.90	$309,746.90	$309,746.90	$309,746.90	$309,746.90	$309,746.90

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local		2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Manitoba		2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		4.24	4.16	4.44	4.55	6.91	5.80	5.14
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.38	0.38	0.38	0.38	0.38	0.38	0.38
	-rest of Manitoba		1.61	1.62	1.60	1.60	1.62	1.60	1.60
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.99	2.00	1.98	1.98	2.00	1.98	1.98
SUBTOTAL	-local		3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba		4.49	4.46	4.57	4.63	5.83	5.26	4.93
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		7.60	7.53	7.78	7.90	10.28	9.14	8.49

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.82	1.79	1.91	1.97	2.98	2.51	2.22
	-rest of Canada	1.91	1.87	2.00	2.06	3.12	2.63	2.32
	-total	3.73	3.66	3.92	4.02	6.10	5.14	4.55
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.24	2.21	2.33	2.38	3.40	2.93	2.64
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	4.30	4.22	4.48	4.59	6.66	5.71	5.11
TOTAL SHORT TERM	-local	3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba	6.73	6.66	6.91	7.02	9.23	8.19	7.57
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	11.90	11.75	12.26	12.48	16.94	14.85	13.60
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,202,337.36	$1,194,296.96	$1,177,706.36	$1,188,963.62	$1,456,596.80	$1,913,400.67	$1,245,249.92
- Risk Level 1		$1,208,823.70	$1,200,783.30	$1,184,192.70	$1,195,449.96	$1,463,083.14	$1,919,887.01	$1,251,736.26
- Risk Level 2		$1,215,310.13	$1,207,269.73	$1,190,679.13	$1,201,936.39	$1,469,569.57	$1,926,373.44	$1,258,222.69
- Risk Level 3		$1,228,282.89	$1,220,242.50	$1,203,651.90	$1,214,909.16	$1,482,542.34	$1,939,346.21	$1,271,195.46
TOTAL PV INCREMENTAL BENEFITS		$1,694,408.34	$1,694,408.34	$1,694,408.34	$1,694,408.34	$1,694,408.34	$1,694,408.34	$1,694,408.34
PVB/PVC (INCREMENTAL)								
- Risk Level 0		1.40926	1.41875	1.43874	1.42511	1.16327	0.88555	1.36070
- Risk Level 1		1.40170	1.41109	1.43086	1.41738	1.15811	0.88256	1.35365
- Risk Level 2		1.39422	1.40350	1.42306	1.40973	1.15300	0.87958	1.34667
- Risk Level 3		1.37949	1.38858	1.40772	1.39468	1.14291	0.87370	1.33293

Table C2

AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS
FOR SPLIT LAKE
Population 1026

A/C: DHC-6
Temp: 22 C
Elev: 1000 ft
GTOW: 10000 lbs
(non-instrument runway) CAR-3

a)

CIVIL WORKS	PAVEMENT TYPE (P)						
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$247,305.14	$242,893.97	$252,443.41	$256,375.67	$336,752.09	$510,006.44	$276,036.97
Subtotals	$400,942.64	$392,868.97	$420,730.91	$431,988.17	$655,202.09	$1,158,081.44	$488,274.47
(strip length = 426 m.)							
(graded area width = 38 m.)							
(runway pavement width = 15.2 m. max to 7.6 m. min)							
(runway pavement length = 366 m.); gravel= 372 ; turf= 377							
Civil works Subtotals: 1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
3+4+5 :	$269,492.64	$264,218.97	$278,080.91	$283,738.17	$397,752.09	$648,631.44	$312,024.47

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$16,633.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$81,233.00

Grand Totals	$682,175.64	$674,101.97	$701,963.91	$713,221.17	$936,435.09	$1,439,314.44	$769,507.47

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$7,950.84	$8,037.16	$11,796.78	$11,796.78	$7,950.84	$0.00	$11,796.78
	PV	$3,065.37	$3,098.65	$1,656.22	$1,656.22	$3,065.37	$0.00	$1,656.22
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC	Annual	$417.56	$417.56	$411.39	$411.39	$417.56	$411.39	$411.39
	PV	$3,554.95	$3,554.95	$3,502.41	$3,502.41	$3,554.95	$3,502.41	$3,502.41
h) Incremental Reg. Pass. Serv. DOC (60% LF)	Annual	$12,799.12	$12,799.12	$12,609.97	$12,609.97	$12,799.12	$12,609.97	$12,609.97
	PV	$108,966.58	$108,966.58	$107,356.24	$107,356.24	$108,966.58	$107,356.24	$107,356.24
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$11,171.24	$11,171.24	$11,171.24	$11,171.24	$11,171.24	$11,171.24	$11,171.24
	PV	$95,107.47	$95,107.47	$95,107.47	$95,107.47	$95,107.47	$95,107.47	$95,107.47
Risk Level 1 (1.5X)	Annual	$13,126.21	$13,126.21	$13,126.21	$13,126.21	$13,126.21	$13,126.21	$13,126.21
	PV	$111,751.30	$111,751.30	$111,751.30	$111,751.30	$111,751.30	$111,751.30	$111,751.30
Risk Level 2 (2X)	Annual	$15,081.00	$15,081.00	$15,081.00	$15,081.00	$15,081.00	$15,081.00	$15,081.00
	PV	$128,393.60	$128,393.60	$128,393.60	$128,393.60	$128,393.60	$128,393.60	$128,393.60
Risk Level 3 (3X)	Annual	$18,991.11	$18,991.11	$18,991.11	$18,991.11	$18,991.11	$18,991.11	$18,991.11
	PV	$161,682.71	$161,682.71	$161,682.71	$161,682.71	$161,682.71	$161,682.71	$161,682.71

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 1026)								
a) Emergency Health Care								
-lives saved (1.90/yr)	Annual	$451,308.67	$451,308.67	$451,308.67	$451,308.67	$451,308.67	$451,308.67	$451,308.67
	PV	$3,842,261.49	$3,842,261.49	$3,842,261.49	$3,842,261.49	$3,842,261.49	$3,842,261.49	$3,842,261.49
-permanent disabilities	Annual	$175,191.55	$175,191.55	$175,191.55	$175,191.55	$175,191.55	$175,191.55	$175,191.55
prevented (3.81/yr)	PV	$1,491,510.78	$1,491,510.78	$1,491,510.78	$1,491,510.78	$1,491,510.78	$1,491,510.78	$1,491,510.78
-temp disability-lost	Annual	$829.81	$829.81	$829.81	$829.81	$829.81	$829.81	$829.81
work days saved (59.51/yr)	PV	$7,064.67	$7,064.67	$7,064.67	$7,064.67	$7,064.67	$7,064.67	$7,064.67
b) Air Service User Time	Annual	$111,195.22	$111,195.22	$111,195.22	$111,195.22	$111,195.22	$111,195.22	$111,195.22
Savings (11,270 hrs/yr)	PV	$946,671.62	$946,671.62	$946,671.62	$946,671.62	$946,671.62	$946,671.62	$946,671.62

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local		2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Manitoba		2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		4.24	4.16	4.44	4.55	6.91	5.80	5.14
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.38	0.38	0.38	0.38	0.38	0.38	0.38
	-rest of Manitoba		1.61	1.62	1.60	1.60	1.62	1.60	1.60
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.99	2.00	1.98	1.98	2.00	1.98	1.98
SUBTOTAL	-local		3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba		4.49	4.46	4.57	4.63	5.83	5.26	4.93
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		7.60	7.53	7.78	7.90	10.28	9.14	8.49

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.82	1.79	1.91	1.97	2.98	2.51	2.22
	-rest of Canada	1.91	1.87	2.00	2.06	3.12	2.63	2.32
	-total	3.73	3.66	3.92	4.02	6.10	5.14	4.55
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.24	2.21	2.33	2.38	3.40	2.93	2.64
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	4.30	4.22	4.48	4.59	6.66	5.71	5.11
TOTAL SHORT TERM	-local	3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba	6.73	6.66	6.91	7.02	9.23	8.19	7.57
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	11.90	11.75	12.26	12.48	16.94	14.85	13.60
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,342,984.84	$1,334,944.44	$1,317,133.08	$1,328,390.34	$1,597,244.28	$2,052,827.39	$1,384,676.64
- Risk Level 1		$1,359,628.67	$1,351,588.28	$1,333,776.91	$1,345,034.17	$1,613,888.11	$2,069,471.22	$1,401,320.47
- Risk Level 2		$1,376,270.97	$1,368,230.58	$1,350,419.21	$1,361,676.47	$1,630,530.41	$2,086,113.52	$1,417,962.77
- Risk Level 3		$1,409,560.08	$1,401,519.69	$1,383,708.32	$1,394,965.58	$1,663,819.53	$2,119,402.63	$1,451,251.88
TOTAL PV INCREMENTAL BENEFITS		$6,287,508.57	$6,287,508.57	$6,287,508.57	$6,287,508.57	$6,287,508.57	$6,287,508.57	$6,287,508.57
PVB/PVC (INCREMENTAL)								
- Risk Level 0		4.68174	4.70994	4.77363	4.73318	3.93647	3.06285	4.54078
- Risk Level 1		4.62443	4.65194	4.71406	4.67461	3.89588	3.03822	4.48685
- Risk Level 2		4,56851	4.59536	4.65597	4.61748	3.85611	3.01398	4.43418
- Risk Level 3		4.46062	4.48621	4.54396	4.50729	3.77896	2.96664	4.33247

file; DAUPHIN
28-Aug-85

AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS
FOR DAUPHIN RIVER
Population 97

A/C: DHC-6
Temp: 22 C
Elev: 1000 ft
GTOW: 10000 lbs
CAR-3

(non-instrument runway)

a)

CIVIL WORKS	PAVEMENT TYPE (P)						
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
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5. Runway (non-instrument)	$247,305.14	$242,893.97	$252,443.41	$256,375.67	$336,752.09	$510,006.44	$276,036.97
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(strip length = 426 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 366 m.); gravel= 372 ; turf= 377

Civil works Subtotals:							
1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
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	Cost
Air Terminal Building	$16,000.00
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Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
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Edge Lighting	$16,633.00
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Grand Totals	$682,175.64	$674,101.97	$701,963.91	$713,221.17	$936,435.09	$1,439,314.44	$769,507.47

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$7,950.84	$8,037.16	$11,796.78	$11,796.78	$7,950.84	$0.00	$11,796.78
	PV	$3,065.37	$3,098.65	$1,656.22	$1,656.22	$3,065.37	$0.00	$1,656.22
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Energ. Serv. DOC	Annual	$61.31	$61.31	$60.40	$60.40	$61.31	$60.40	$60.40
	PV	$521.93	$521.93	$514.22	$514.22	$521.93	$514.22	$514.22
h) Incremental Reg. Pass. Serv. DOC (60% LF)	Annual	$1,210.05	$1,210.05	$1,192.17	$1,192.17	$1,210.05	$1,192.17	$1,192.17
	PV	$10,301.90	$10,301.90	$10,149.66	$10,149.66	$10,301.90	$10,149.66	$10,149.66
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$1,131.55	$1,131.55	$1,131.55	$1,131.55	$1,131.55	$1,131.55	$1,131.55
	PV	$9,633.56	$9,633.56	$9,633.56	$9,633.56	$9,633.56	$9,633.56	$9,633.56
Risk Level 1 (1.5X)	Annual	$1,329.57	$1,329.57	$1,329.57	$1,329.57	$1,329.57	$1,329.57	$1,329.57
	PV	$11,319.43	$11,319.43	$11,319.43	$11,319.43	$11,319.43	$11,319.43	$11,319.43
Risk Level 2 (2X)	Annual	$1,527.59	$1,527.59	$1,527.59	$1,527.59	$1,527.59	$1,527.59	$1,527.59
	PV	$13,005.29	$13,005.29	$13,005.29	$13,005.29	$13,005.29	$13,005.29	$13,005.29
Risk Level 3 (3X)	Annual	$1,923.64	$1,923.64	$1,923.64	$1,923.64	$1,923.64	$1,923.64	$1,923.64
	PV	$16,377.10	$16,377.10	$16,377.10	$16,377.10	$16,377.10	$16,377.10	$16,377.10

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 97)								
a) Emergency Health Care								
-lives saved (0.18/yr)	Annual	$42,667.58	$42,667.58	$42,667.58	$42,667.58	$42,667.58	$42,667.58	$42,667.58
	PV	$363,254.71	$363,254.71	$363,254.71	$363,254.71	$363,254.71	$363,254.71	$363,254.71
-permanent disabilities	Annual	$16,562.94	$16,562.94	$16,562.94	$16,562.94	$16,562.94	$16,562.94	$16,562.94
prevented (.36/yr)	PV	$141,010.25	$141,010.25	$141,010.25	$141,010.25	$141,010.25	$141,010.25	$141,010.25
-temp disability-lost	Annual	$78.45	$78.45	$78.45	$78.45	$78.45	$78.45	$78.45
work days saved (5.63/yr)	PV	$667.89	$667.89	$667.89	$667.89	$667.89	$667.89	$667.89
b) Air Service User Time	Annual	$10,627.27	$10,627.27	$10,627.27	$10,627.27	$10,627.27	$10,627.27	$10,627.27
Savings (1,077 hrs/yr)	PV	$90,476.33	$90,476.33	$90,476.33	$90,476.33	$90,476.33	$90,476.33	$90,476.33

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local		2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Manitoba		2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		4.24	4.16	4.44	4.55	6.91	5.80	5.14
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.38	0.38	0.38	0.38	0.38	0.38	0.38
	-rest of Manitoba		1.61	1.62	1.60	1.60	1.62	1.60	1.60
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.99	2.00	1.98	1.98	2.00	1.98	1.98
SUBTOTAL	-local		3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba		4.49	4.46	4.57	4.63	5.83	5.26	4.93
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		7.60	7.53	7.78	7.90	10.28	9.14	8.49

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.82	1.79	1.91	1.97	2.98	2.51	2.22
	-rest of Canada	1.91	1.87	2.00	2.06	3.12	2.63	2.32
	-total	3.73	3.66	3.92	4.02	6.10	5.14	4.55
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.24	2.21	2.33	2.38	3.40	2.93	2.64
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	4.30	4.22	4.48	4.59	6.66	5.71	5.11
TOTAL SHORT TERM	-local	3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba	6.73	6.66	6.91	7.02	9.23	8.19	7.57
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	11.90	11.75	12.26	12.48	16.94	14.85	13.60
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,155,813.24	$1,147,772.85	$1,131,464.40	$1,142,721.66	$1,410,072.68	$1,867,158.71	$1,199,007.96
- Risk Level 1		$1,157,499.11	$1,149,458.71	$1,133,150.26	$1,144,407.52	$1,411,758.55	$1,868,844.58	$1,200,693.82
- Risk Level 2		$1,159,184.97	$1,151,144.57	$1,134,836.13	$1,146,093.39	$1,413,444.41	$1,870,530.44	$1,202,379.69
- Risk Level 3		$1,162,556.78	$1,154,516.38	$1,138,207.94	$1,149,465.20	$1,416,816.22	$1,873,902.25	$1,205,751.50
TOTAL PV INCREMENTAL BENEFITS		$595,409.17	$595,409.17	$595,409.17	$595,409.17	$595,409.17	$595,409.17	$595,409.17
PVB/PVC (INCREMENTAL)								
- Risk Level 0		0.51514	0.51875	0.52623	0.52104	0.42225	0.31889	0.49658
- Risk Level 1		0.51439	0.51799	0.52545	0.52028	0.42175	0.31860	0.49589
- Risk Level 2		0.51364	0.51723	0.52467	0.51951	0.42125	0.31831	0.49519
- Risk Level 3		0.51215	0.51572	0.52311	0.51799	0.42024	0.31774	0.49381

Table C4

AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS
FOR WASSAGOMACH
Population 660

A/C: DHC-6
Temp: 22 C
Elev: 1000 ft
GTOW: 10000 lbs
(non-instrument runway) CAR-3

a)

CIVIL WORKS		PAVEMENT TYPE (P)						
		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.		$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)		$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)		$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)		$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)		$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)		$247,305.14	$242,893.97	$252,443.41	$256,375.67	$336,752.09	$510,006.44	$276,036.97
	Subtotals	$400,942.64	$392,868.97	$420,730.91	$431,988.17	$655,202.09	$1,158,081.44	$488,274.47
(strip length = 426 m.)								
(graded area width = 38 m.)								
(runway pavement width = 15.2 m. max to 7.6 m. min)								
(runway pavement length = 366 m.); gravel=	372 ;	turf=	377					
Civil works Subtotals:	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$269,492.64	$264,218.97	$278,080.91	$283,738.17	$397,752.09	$648,631.44	$312,024.47

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$16,633.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$81,233.00

Grand Totals	$682,175.64	$674,101.97	$701,963.91	$713,221.17	$936,435.09	$1,439,314.44	$769,507.47

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$7,950.84	$8,037.16	$11,796.78	$11,796.78	$7,950.84	$0.00	$11,796.78
	PV	$3,065.37	$3,098.65	$1,656.22	$1,656.22	$3,065.37	$0.00	$1,656.22
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC	Annual	$550.58	$550.58	$542.44	$542.44	$550.58	$542.44	$542.44
	PV	$4,687.39	$4,687.39	$4,618.12	$4,618.12	$4,687.39	$4,618.12	$4,618.12
h) Incremental Reg. Pass. Serv. DOC (60% LF)	Annual	$8,233.36	$8,233.36	$8,111.68	$8,111.68	$8,233.36	$8,111.68	$8,111.68
	PV	$70,095.49	$70,095.49	$69,059.60	$69,059.60	$70,095.49	$69,059.60	$69,059.60
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$7,888.02	$7,888.02	$7,888.02	$7,888.02	$7,888.02	$7,888.02	$7,888.02
	PV	$67,155.45	$67,155.45	$67,155.45	$67,155.45	$67,155.45	$67,155.45	$67,155.45
Risk Level 1 (1.5X)	Annual	$9,268.43	$9,268.43	$9,268.43	$9,268.43	$9,268.43	$9,268.43	$9,268.43
	PV	$78,907.71	$78,907.71	$78,907.71	$78,907.71	$78,907.71	$78,907.71	$78,907.71
Risk Level 2 (2X)	Annual	$10,648.83	$10,648.83	$10,648.83	$10,648.83	$10,648.83	$10,648.83	$10,648.83
	PV	$90,659.88	$90,659.88	$90,659.88	$90,659.88	$90,659.88	$90,659.88	$90,659.88
Risk Level 3 (3X)	Annual	$13,409.64	$13,409.64	$13,409.64	$13,409.64	$13,409.64	$13,409.64	$13,409.64
	PV	$114,164.31	$114,164.31	$114,164.31	$114,164.31	$114,164.31	$114,164.31	$114,164.31

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop =·660)								
a) Emergency Health Care								
-lives saved (1.22/yr)	Annual	$290,315.52	$290,315.52	$290,315.52	$290,315.52	$290,315.52	$290,315.52	$290,315.52
	PV	$2,471,630.21	$2,471,630.21	$2,471,630.21	$2,471,630.21	$2,471,630.21	$2,471,630.21	$2,471,630.21
-permanent disabilities	Annual	$112,696.32	$112,696.32	$112,696.32	$112,696.32	$112,696.32	$112,696.32	$112,696.32
prevented (2.45/yr)	PV	$959,451.39	$959,451.39	$959,451.39	$959,451.39	$959,451.39	$959,451.39	$959,451.39
-temp disability-lost	Annual	$533.80	$533.80	$533.80	$533.80	$533.80	$533.80	$533.80
work days saved (38.28/yr)	PV	$4,544.56	$4,544.56	$4,544.56	$4,544.56	$4,544.56	$4,544.56	$4,544.56
b) Air Service User Time	Annual	$75,167.04	$75,167.04	$75,167.04	$75,167.04	$75,167.04	$75,167.04	$75,167.04
Savings (7618 hrs/yr)	PV	$639,942.11	$639,942.11	$639,942.11	$639,942.11	$639,942.11	$639,942.11	$639,942.11

c) Employment (person-yrs)

-long term (annual)	-local	1.8
	-rest of Manitoba	0
	-rest of Canada	0
	-total	1.8

-short term direct:

civil works	-local	2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Manitoba	2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	4.24	4.16	4.44	4.55	6.91	5.80	5.14
ATB	-local	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local	0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba	0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local	0.38	0.38	0.38	0.38	0.38	0.38	0.38
	-rest of Manitoba	1.61	1.62	1.60	1.60	1.62	1.60	1.60
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.99	2.00	1.98	1.98	2.00	1.98	1.98
SUBTOTAL	-local	3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba	4.49	4.46	4.57	4.63	5.83	5.26	4.93
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	7.60	7.53	7.78	7.90	10.28	9.14	8.49

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.82	1.79	1.91	1.97	2.98	2.51	2.22
	-rest of Canada	1.91	1.87	2.00	2.06	3.12	2.63	2.32
	-total	3.73	3.66	3.92	4.02	6.10	5.14	4.55
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.24	2.21	2.33	2.38	3.40	2.93	2.64
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	4.30	4.22	4.48	4.59	6.66	5.71	5.11
TOTAL SHORT TERM	-local	3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba	6.73	6.66	6.91	7.02	9.23	8.19	7.57
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	11.90	11.75	12.26	12.48	16.94	14.85	13.60
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,277,294.17	$1,269,253.77	$1,252,000.12	$1,263,257.38	$1,531,553.61	$1,987,694.43	$1,319,543.68
- Risk Level 1		$1,289,046.43	$1,281,006.03	$1,263,752.38	$1,275,009.64	$1,543,305.87	$1,999,446.69	$1,331,295.94
- Risk Level 2		$1,300,798.60	$1,292,758.21	$1,275,504.55	$1,286,761.81	$1,555,058.04	$2,011,198.87	$1,343,048.11
- Risk Level 3		$1,324,303.03	$1,316,262.64	$1,299,008.99	$1,310,266.25	$1,578,562.48	$2,034,703.30	$1,366,552.55
TOTAL PV INCREMENTAL BENEFITS		$4,075,568.27	$4,075,568.27	$4,075,568.27	$4,075,568.27	$4,075,568.27	$4,075,568.27	$4,075,568.27
PVB/PVC (INCREMENTAL)								
- Risk Level 0		3.19078	3.21100	3.25525	3.22624	2.66107	2.05040	3.08862
- Risk Level 1		3.16169	3.18154	3.22497	3.19650	2.64080	2.03835	3.06135
- Risk Level 2		3.13313	3.15261	3.19526	3.16731	2.62085	2.02644	3.03457
- Risk Level 3		3.07752	3.09632	3.13744	3.11049	2.58182	2.00303	2.98237

file; GRANDVILL
28-Aug-85

Table C5

AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS
FOR GRANDVILLE LAKE
Population 90

A/C: DHC-6
Temp: 22 C
Elev: 1000 ft
GTOW: 10000 lbs
CAR-3

(non-instrument runway)

a)

CIVIL WORKS	PAVEMENT TYPE (P)						
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$247,305.14	$242,893.97	$252,443.41	$256,375.67	$336,752.09	$510,006.44	$276,036.97
Subtotals	$400,942.64	$392,868.97	$420,730.91	$431,988.17	$655,202.09	$1,158,081.44	$488,274.47

(strip length = 426 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 366 m.); gravel= 372 ; turf= 377

Civil works Subtotals:								
	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$269,492.64	$264,218.97	$278,080.91	$283,738.17	$397,752.09	$648,631.44	$312,024.47

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$16,633.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$81,233.00

	Grand Totals	$682,175.64	$674,101.97	$701,963.91	$713,221.17	$936,435.09	$1,439,314.44	$769,507.47

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$7,950.84	$8,037.16	$11,796.78	$11,796.78	$7,950.84	$0.00	$11,796.78
	PV	$3,065.37	$3,098.65	$1,656.22	$1,656.22	$3,065.37	$0.00	$1,656.22
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental								
A/C Energ. Serv. DOC	Annual	$75.08	$75.08	$73.97	$73.97	$75.08	$73.97	$73.97
	PV	$639.20	$639.20	$629.75	$629.75	$639.20	$629.75	$629.75
h) Incremental								
Reg. Pass. Serv. DOC	Annual	$1,122.73	$1,122.73	$1,106.14	$1,106.14	$1,122.73	$1,106.14	$1,106.14
(60% LF)	PV	$9,558.49	$9,558.49	$9,417.23	$9,417.23	$9,558.49	$9,417.23	$9,417.23
i) Incremental								
A/C Accident Costs								
Risk Level 0	Annual	$1,049.89	$1,049.89	$1,049.89	$1,049.89	$1,049.89	$1,049.89	$1,049.89
	PV	$8,938.34	$8,938.34	$8,938.34	$8,938.34	$8,938.34	$8,938.34	$8,938.34
Risk Level 1	Annual	$1,233.62	$1,233.62	$1,233.62	$1,233.62	$1,233.62	$1,233.62	$1,233.62
(1.5X)	PV	$10,502.55	$10,502.55	$10,502.55	$10,502.55	$10,502.55	$10,502.55	$10,502.55
Risk Level 2	Annual	$1,417.35	$1,417.35	$1,417.35	$1,417.35	$1,417.35	$1,417.35	$1,417.35
(2X)	PV	$12,066.75	$12,066.75	$12,066.75	$12,066.75	$12,066.75	$12,066.75	$12,066.75
Risk Level 3	Annual	$1,784.82	$1,784.82	$1,784.82	$1,784.82	$1,784.82	$1,784.82	$1,784.82
(3X)	PV	$15,195.24	$15,195.24	$15,195.24	$15,195.24	$15,195.24	$15,195.24	$15,195.24

j) Mobile Equipment Replacement									
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	
INCREMENTAL BENEFIT SUMMARY (Community pop = 90)									
a) Emergency Health Care									
-lives saved (0.17/yr)	Annual	$39,588.48	$39,588.48	$39,588.48	$39,588.48	$39,588.48	$39,588.48	$39,588.48	
	PV	$337,040.48	$337,040.48	$337,040.48	$337,040.48	$337,040.48	$337,040.48	$337,040.48	
-permanent disabilities	Annual	$15,367.68	$15,367.68	$15,367.68	$15,367.68	$15,367.68	$15,367.68	$15,367.68	
prevented (0.33/yr)	PV	$130,834.28	$130,834.28	$130,834.28	$130,834.28	$130,834.28	$130,834.28	$130,834.28	
-temp disability-lost	Annual	$72.79	$72.79	$72.79	$72.79	$72.79	$72.79	$72.79	
work days saved (5.22/yr)	PV	$619.70	$619.70	$619.70	$619.70	$619.70	$619.70	$619.70	
b) Air Service User Time	Annual	$9,860.35	$9,860.35	$9,860.35	$9,860.35	$9,860.35	$9,860.35	$9,860.35	
Savings (999 hrs/yr)	PV	$83,947.08	$83,947.08	$83,947.08	$83,947.08	$83,947.08	$83,947.08	$83,947.08	

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local		2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Manitoba		2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		4.24	4.16	4.44	4.55	6.91	5.80	5.14
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.38	0.38	0.38	0.38	0.38	0.38	0.38
	-rest of Manitoba		1.61	1.62	1.60	1.60	1.62	1.60	1.60
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.99	2.00	1.98	1.98	2.00	1.98	1.98
SUBTOTAL	-local		3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba		4.49	4.46	4.57	4.63	5.83	5.26	4.93
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		7.60	7.53	7.78	7.90	10.28	9.14	8.49

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.82	1.79	1.91	1.97	2.98	2.51	2.22
	-rest of Canada	1.91	1.87	2.00	2.06	3.12	2.63	2.32
	-total	3.73	3.66	3.92	4.02	6.10	5.14	4.55
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.24	2.21	2.33	2.38	3.40	2.93	2.64
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	4.30	4.22	4.48	4.59	6.66	5.71	5.11
TOTAL SHORT TERM	-local	3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba	6.73	6.66	6.91	7.02	9.23	8.19	7.57
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	11.90	11.75	12.26	12.48	16.94	14.85	13.60
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,154,491.87	$1,146,451.48	$1,130,152.29	$1,141,409.55	$1,408,751.32	$1,865,846.60	$1,197,695.85
- Risk Level 1		$1,156,056.08	$1,148,015.68	$1,131,716.49	$1,142,973.75	$1,410,315.52	$1,867,410.80	$1,199,260.05
- Risk Level 2		$1,157,620.28	$1,149,579.88	$1,133,280.69	$1,144,537.95	$1,411,879.72	$1,868,975.01	$1,200,824.25
- Risk Level 3		$1,160,748.77	$1,152,708.38	$1,136,409.19	$1,147,666.45	$1,415,008.22	$1,872,103.50	$1,203,952.75
TOTAL PV INCREMENTAL BENEFITS		$552,441.54	$552,441.54	$552,441.54	$552,441.54	$552,441.54	$552,441.54	$552,441.54
PVB/PVC (INCREMENTAL)								
- Risk Level 0		0.47851	0.48187	0.48882	0.48400	0.39215	0.29608	0.46125
- Risk Level 1		0.47787	0.48121	0.48814	0.48334	0.39171	0.29583	0.46065
- Risk Level 2		0.47722	0.48056	0.48747	0.48268	0.39128	0.29559	0.46005
- Risk Level 3		0.47594	0.47926	0.48613	0.48136	0.39042	0.29509	0.45886

Table C6

AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS
FOR JACKHEAD
Population 199

A/C: DHC-6
Temp: 22 C
Elev: 1000 ft
GTOW: 10000 lbs
(non-instrument runway) CAR-3

a)

CIVIL WORKS	PAVEMENT TYPE (P)						
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
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5. Runway (non-instrument)	$247,305.14	$242,893.97	$252,443.41	$256,375.67	$336,752.09	$510,006.44	$276,036.97
Subtotals	$400,942.64	$392,868.97	$420,730.91	$431,988.17	$655,202.09	$1,158,081.44	$488,274.47

(strip length = 426 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 366 m.); gravel= 372 ; turf= 377

Civil works Subtotals:							
1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
3+4+5 :	$269,492.64	$264,218.97	$278,080.91	$283,738.17	$397,752.09	$648,631.44	$312,024.47

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$16,633.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
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Subtotal	$81,233.00

Grand Totals	$682,175.64	$674,101.97	$701,963.91	$713,221.17	$936,435.09	$1,439,314.44	$769,507.47

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$7,950.84	$8,037.16	$11,796.78	$11,796.78	$7,950.84	$0.00	$11,796.78
	PV	$3,065.37	$3,098.65	$1,656.22	$1,656.22	$3,065.37	$0.00	$1,656.22
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Increamental A/C Energ. Serv. DOC	Annual	$125.77	$125.77	$123.91	$123.91	$125.77	$123.91	$123.91
	PV	$1,070.74	$1,070.74	$1,054.92	$1,054.92	$1,070.74	$1,054.92	$1,054.92
h) Increamental Reg. Pass. Serv. DOC (60% LF)	Annual	$2,482.48	$2,482.48	$2,445.79	$2,445.79	$2,482.48	$2,445.79	$2,445.79
	PV	$21,134.81	$21,134.81	$20,822.48	$20,822.48	$21,134.81	$20,822.48	$20,822.48
i) Increamental A/C Accident Costs								
Risk Level 0	Annual	$3,752.60	$3,752.60	$3,752.60	$3,752.60	$3,752.60	$3,752.60	$3,752.60
	PV	$31,948.14	$31,948.14	$31,948.14	$31,948.14	$31,948.14	$31,948.14	$31,948.14
Risk Level 1 (1.5X)	Annual	$4,409.31	$4,409.31	$4,409.31	$4,409.31	$4,409.31	$4,409.31	$4,409.31
	PV	$37,539.10	$37,539.10	$37,539.10	$37,539.10	$37,539.10	$37,539.10	$37,539.10
Risk Level 2 (2X)	Annual	$5,066.01	$5,066.01	$5,066.01	$5,066.01	$5,066.01	$5,066.01	$5,066.01
	PV	$43,129.98	$43,129.98	$43,129.98	$43,129.98	$43,129.98	$43,129.98	$43,129.98
Risk Level 3 (3X)	Annual	$6,379.42	$6,379.42	$6,379.42	$6,379.42	$6,379.42	$6,379.42	$6,379.42
	PV	$54,311.83	$54,311.83	$54,311.83	$54,311.83	$54,311.83	$54,311.83	$54,311.83

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 199)								
a) Emergency Health Care								
-lives saved (0.37/yr)	Annual	$87,534.53	$87,534.53	$87,534.53	$87,534.53	$87,534.53	$87,534.53	$87,534.53
	PV	$745,233.97	$745,233.97	$745,233.97	$745,233.97	$745,233.97	$745,233.97	$745,233.97
-permanent disabilities	Annual	$33,979.65	$33,979.65	$33,979.65	$33,979.65	$33,979.65	$33,979.65	$33,979.65
prevented (0.74/yr)	PV	$289,289.15	$289,289.15	$289,289.15	$289,289.15	$289,289.15	$289,289.15	$289,289.15
-temp disability-lost	Annual	$160.95	$160.95	$160.95	$160.95	$160.95	$160.95	$160.95
work days saved (11.54/yr)	PV	$1,370.26	$1,370.26	$1,370.26	$1,370.26	$1,370.26	$1,370.26	$1,370.26
b) Air Service User Time	Annual	$29,787.28	$29,787.28	$29,787.28	$29,787.28	$29,787.28	$29,787.28	$29,787.28
Savings (3019 hrs/yr)	PV	$253,596.99	$253,596.99	$253,596.99	$253,596.99	$253,596.99	$253,596.99	$253,596.99

c) Employment (person-yrs)

-long term (annual)-local		1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local	2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Manitoba	2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	4.24	4.16	4.44	4.55	6.91	5.80	5.14
ATB	-local	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local	0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba	0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local	0.38	0.38	0.38	0.38	0.38	0.38	0.38
	-rest of Manitoba	1.61	1.62	1.60	1.60	1.62	1.60	1.60
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.99	2.00	1.98	1.98	2.00	1.98	1.98
SUBTOTAL	-local	3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba	4.49	4.46	4.57	4.63	5.83	5.26	4.93
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	7.60	7.53	7.78	7.90	10.28	9.14	8.49

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.82	1.79	1.91	1.97	2.98	2.51	2.22
	-rest of Canada	1.91	1.87	2.00	2.06	3.12	2.63	2.32
	-total	3.73	3.66	3.92	4.02	6.10	5.14	4.55
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.24	2.21	2.33	2.38	3.40	2.93	2.64
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	4.30	4.22	4.48	4.59	6.66	5.71	5.11
TOTAL SHORT TERM	-local	3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba	6.73	6.66	6.91	7.02	9.23	8.19	7.57
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	11.90	11.75	12.26	12.48	16.94	14.85	13.60
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,189,509.53	$1,181,469.14	$1,164,992.49	$1,176,249.75	$1,443,768.98	$1,900,686.80	$1,232,536.05
- Risk Level 1		$1,195,100.50	$1,187,060.11	$1,170,583.46	$1,181,840.72	$1,449,359.94	$1,906,277.77	$1,238,127.02
- Risk Level 2		$1,200,691.38	$1,192,650.99	$1,176,174.34	$1,187,431.60	$1,454,950.82	$1,911,868.65	$1,243,717.90
- Risk Level 3		$1,211,873.23	$1,203,832.83	$1,187,356.19	$1,198,613.45	$1,466,132.67	$1,923,050.50	$1,254,899.75
TOTAL PV INCREMENTAL BENEFITS		$1,289,490.37	$1,289,490.37	$1,289,490.37	$1,289,490.37	$1,289,490.37	$1,289,490.37	$1,289,490.37
PVB/PVC (INCREMENTAL)								
- Risk Level 0		1.08405	1.09143	1.10687	1.09627	0.89314	0.67843	1.04621
- Risk Level 1		1.07898	1.08629	1.10158	1.09109	0.88970	0.67644	1.04148
- Risk Level 2		1.07396	1.08120	1.09634	1.08595	0.88628	0.67447	1.03680
- Risk Level 3		1.06405	1.07115	1.08602	1.07582	0.87952	0.67054	1.02756

file: PELICAN
28-Aug-85

Table C7

AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS
FOR PELICAN RAPIDS
Population 236

A/C: DHC-6
Temp: 22 C
Elev: 1000 ft
GTOW: 10000 lbs
(non-instrument runway) CAR-3

a)

CIVIL WORKS	PAVEMENT TYPE (P)						
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$247,305.14	$242,893.97	$252,443.41	$256,375.67	$336,752.09	$510,006.44	$276,036.97
Subtotals	$400,942.64	$392,868.97	$420,730.91	$431,988.17	$655,202.09	$1,158,081.44	$488,274.47

(strip length = 426 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 366 m.);gravel= 372 ; turf= 377

Civil works Subtotals:							
1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
3+4+5 :	$269,492.64	$264,218.97	$278,080.91	$283,738.17	$397,752.09	$648,631.44	$312,024.47

b) AIR TERMINAL BUILDING AND
RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$16,633.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$81,233.00

	Grand Totals	$682,175.64	$674,101.97	$701,963.91	$713,221.17	$936,435.09	$1,439,314.44	$769,507.47

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$7,950.84	$8,037.16	$11,796.78	$11,796.78	$7,950.84	$0.00	$11,796.78
	PV	$3,065.37	$3,098.65	$1,656.22	$1,656.22	$3,065.37	$0.00	$1,656.22
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Energ. Serv. DOC	Annual	$259.15	$259.15	$255.32	$255.32	$259.15	$255.32	$255.32
	PV	$2,206.30	$2,206.30	$2,173.69	$2,173.69	$2,206.30	$2,173.69	$2,173.69
h) Incremental Reg. Pass. Serv. DOC (60% LF)	Annual	$2,944.05	$2,944.05	$2,900.54	$2,900.54	$2,944.05	$2,900.54	$2,900.54
	PV	$25,064.45	$25,064.45	$24,694.04	$24,694.04	$25,064.45	$24,694.04	$24,694.04
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$4,084.51	$4,084.51	$4,084.51	$4,084.51	$4,084.51	$4,084.51	$4,084.51
	PV	$34,773.88	$34,773.88	$34,773.88	$34,773.88	$34,773.88	$34,773.88	$34,773.88
Risk Level 1 (1.5X)	Annual	$4,799.30	$4,799.30	$4,799.30	$4,799.30	$4,799.30	$4,799.30	$4,799.30
	PV	$40,859.32	$40,859.32	$40,859.32	$40,859.32	$40,859.32	$40,859.32	$40,859.32
Risk Level 2 (2X)	Annual	$5,514.09	$5,514.09	$5,514.09	$5,514.09	$5,514.09	$5,514.09	$5,514.09
	PV	$46,944.76	$46,944.76	$46,944.76	$46,944.76	$46,944.76	$46,944.76	$46,944.76
Risk Level 3 (3X)	Annual	$6,943.67	$6,943.67	$6,943.67	$6,943.67	$6,943.67	$6,943.67	$6,943.67
	PV	$59,115.63	$59,115.63	$59,115.63	$59,115.63	$59,115.63	$59,115.63	$59,115.63

j) Mobile Equipment Replacement									
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	
INCREMENTAL BENEFIT SUMMARY (Community pop = 236)									
a) Emergency Health Care									
-lives saved (0.44/yr)	Annual	$103,809.79	$103,809.79	$103,809.79	$103,809.79	$103,809.79	$103,809.79	$103,809.79	
	PV	$883,795.03	$883,795.03	$883,795.03	$883,795.03	$983,795.03	$883,795.03	$883,795.03	
-permanent disabilities	Annual	$40,297.47	$40,297.47	$40,297.47	$40,297.47	$40,297.47	$40,297.47	$40,297.47	
prevented (0.88/yr)	PV	$343,076.54	$343,076.54	$343,076.54	$343,076.54	$343,076.54	$343,076.54	$343,076.54	
-temp disability-lost	Annual	$190.87	$190.87	$190.87	$190.87	$190.87	$190.87	$190.87	
work days saved (13.69/yr)	PV	$1,624.99	$1,624.99	$1,624.99	$1,624.99	$1,624.99	$1,624.99	$1,624.99	
b) Air Service User Time	Annual	$33,429.47	$33,429.47	$33,429.47	$33,429.47	$33,429.47	$33,429.47	$33,429.47	
Savings (3388 hrs/yr)	PV	$284,605.14	$284,605.14	$284,605.14	$284,605.14	$284,605.14	$284,605.14	$284,605.14	

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local		2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Manitoba		2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		4.24	4.16	4.44	4.55	6.91	5.80	5.14
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.38	0.38	0.38	0.38	0.38	0.38	0.38
	-rest of Manitoba		1.61	1.62	1.60	1.60	1.62	1.60	1.60
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.99	2.00	1.98	1.98	2.00	1.98	1.98
SUBTOTAL	-local		3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba		4.49	4.46	4.57	4.63	5.83	5.26	4.93
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		7.60	7.53	7.78	7.90	10.28	9.14	8.49

-short term indirect:							
civil works -local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-rest of Manitoba	1.82	1.79	1.91	1.97	2.98	2.51	2.22
-rest of Canada	1.91	1.87	2.00	2.06	3.12	2.63	2.32
-total	3.73	3.66	3.92	4.02	6.10	5.14	4.55
ATB -local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities -local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids -local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL -local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-rest of Manitoba	2.24	2.21	2.33	2.38	3.40	2.93	2.64
-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
-total	4.30	4.22	4.48	4.59	6.66	5.71	5.11
TOTAL SHORT TERM -local	3.11	3.07	3.20	3.26	4.45	3.89	3.56
-rest of Manitoba	6.73	6.66	6.91	7.02	9.23	8.19	7.57
-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
-total	11.90	11.75	12.26	12.48	16.94	14.85	13.60
TOTAL PV INCREMENTAL COSTS							
- Risk Level 0	$1,197,400.47	$1,189,360.07	$1,172,808.57	$1,184,065.83	$1,451,659.91	$1,908,502.88	$1,240,352.13
- Risk Level 1	$1,203,485.91	$1,195,445.51	$1,178,894.01	$1,190,151.27	$1,457,745.35	$1,914,588.32	$1,246,437.57
- Risk Level 2	$1,209,571.34	$1,201,530.95	$1,184,979.44	$1,196,236.70	$1,463,830.78	$1,920,673.76	$1,252,523.00
- Risk Level 3	$1,221,742.21	$1,213,701.82	$1,197,150.32	$1,208,407.58	$1,476,001.66	$1,932,844.63	$1,264,693.88
TOTAL PV INCREMENTAL BENEFITS	$1,513,101.70	$1,513,101.70	$1,513,101.70	$1,513,101.70	$1,513,101.70	$1,513,101.70	$1,513,101.70
PVB/PVC (INCREMENTAL)							
- Risk Level 0	1.26366	1.27220	1.29015	1.27789	1.04233	0.79282	1.21990
- Risk Level 1	1.25727	1.26572	1.28349	1.27135	1.03797	0.79030	1.21394
- Risk Level 2	1.25094	1.25931	1.27690	1.26488	1.03366	0.78780	1.20804
- Risk Level 3	1.23848	1.24668	1.26392	1.25215	1.02514	0.78284	1.19642

Table C8

AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS
FOR PINE DOCK
Population 105

A/C: DHC-6
Temp: 22 C
Elev: 1000 ft
GTOW: 10000 lbs
(non-instrument runway) CAR-3

a)

CIVIL WORKS	PAVEMENT TYPE (P)						
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$247,305.14	$242,893.97	$252,443.41	$256,375.67	$336,752.09	$510,006.44	$276,036.97
Subtotals	$400,942.64	$392,868.97	$420,730.91	$431,988.17	$655,202.09	$1,158,081.44	$488,274.47

(strip length = 426 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 366 m.); gravel= 372 ; turf= 377

Civil works Subtotals:	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$269,492.64	$264,218.97	$278,080.91	$283,738.17	$397,752.09	$648,631.44	$312,024.47

b) AIR TERMINAL BUILDING AND
RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$16,633.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$81,233.00

Grand Totals	$682,175.64	$674,101.97	$701,963.91	$713,221.17	$936,435.09	$1,439,314.44	$769,507.47

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$7,950.84	$8,037.16	$11,796.78	$11,796.78	$7,950.84	$0.00	$11,796.78
	PV	$3,065.37	$3,098.65	$1,656.22	$1,656.22	$3,065.37	$0.00	$1,656.22
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Energ. Serv. DOC	Annual	$66.37	$66.37	$65.39	$65.39	$66.37	$65.39	$65.39
	PV	$565.05	$565.05	$556.70	$556.70	$565.05	$556.70	$556.70
h) Incremental Reg. Pass. Serv. DOC (60% LF)	Annual	$1,309.85	$1,309.85	$1,290.49	$1,290.49	$1,309.85	$1,290.49	$1,290.49
	PV	$11,151.52	$11,151.52	$10,986.72	$10,986.72	$11,151.52	$10,986.72	$10,986.72
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$1,224.87	$1,224.87	$1,224.87	$1,224.87	$1,224.87	$1,224.87	$1,224.87
	PV	$10,428.05	$10,428.05	$10,428.05	$10,428.05	$10,428.05	$10,428.05	$10,428.05
Risk Level 1 (1.5X)	Annual	$1,439.23	$1,439.23	$1,439.23	$1,439.23	$1,439.23	$1,439.23	$1,439.23
	PV	$12,253.03	$12,253.03	$12,253.03	$12,253.03	$12,253.03	$12,253.03	$12,253.03
Risk Level 2 (2X)	Annual	$1,653.58	$1,653.58	$1,653.58	$1,653.58	$1,653.58	$1,653.58	$1,653.58
	PV	$14,077.92	$14,077.92	$14,077.92	$14,077.92	$14,077.92	$14,077.92	$14,077.92
Risk Level 3 (3X)	Annual	$2,082.29	$2,082.29	$2,082.29	$2,082.29	$2,082.29	$2,082.29	$2,082.29
	PV	$17,727.78	$17,727.78	$17,727.78	$17,727.78	$17,727.78	$17,727.78	$17,727.78

j) Mobile Equipment Replacement								
-pickup truck (5 yrs.)	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck (10 yrs.)	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader (10 yrs.)	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments (10 yrs.)	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 105)								
a) Emergency Health Care								
-lives saved (0.19/yr)	Annual	$46,186.56	$46,186.56	$46,186.56	$46,186.56	$46,186.56	$46,186.56	$46,186.56
	PV	$393,213.90	$393,213.90	$393,213.90	$393,213.90	$393,213.90	$393,213.90	$393,213.90
-permanent disabilities prevented (0.39/yr)	Annual	$17,928.96	$17,928.96	$17,928.96	$17,928.96	$17,928.96	$17,928.96	$17,928.96
	PV	$152,639.99	$152,639.99	$152,639.99	$152,639.99	$152,639.99	$152,639.99	$152,639.99
-temp disability-lost work days saved (6.09/yr)	Annual	$84.92	$84.92	$84.92	$84.92	$84.92	$84.92	$84.92
	PV	$722.97	$722.97	$722.97	$722.97	$722.97	$722.97	$722.97
b) Air Service User Time Savings (1166 hrs/yr)	Annual	$11,503.74	$11,503.74	$11,503.74	$11,503.74	$11,503.74	$11,503.74	$11,503.74
	PV	$97,938.24	$97,938.24	$97,938.24	$97,938.24	$97,938.24	$97,938.24	$97,938.24

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local	2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Manitoba	2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	4.24	4.16	4.44	4.55	6.91	5.80	5.14
ATB	-local	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local	0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba	0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local	0.38	0.38	0.38	0.38	0.38	0.38	0.38
	-rest of Manitoba	1.61	1.62	1.60	1.60	1.62	1.60	1.60
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.99	2.00	1.98	1.98	2.00	1.98	1.98
SUBTOTAL	-local	3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba	4.49	4.46	4.57	4.63	5.83	5.26	4.93
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	7.60	7.53	7.78	7.90	10.28	9.14	8.49

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.82	1.79	1.91	1.97	2.98	2.51	2.22
	-rest of Canada	1.91	1.87	2.00	2.06	3.12	2.63	2.32
	-total	3.73	3.66	3.92	4.02	6.10	5.14	4.55
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.24	2.21	2.33	2.38	3.40	2.93	2.64
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	4.30	4.22	4.48	4.59	6.66	5.71	5.11
TOTAL SHORT TERM	-local	3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba	6.73	6.66	6.91	7.02	9.23	8.19	7.57
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	11.90	11.75	12.26	12.48	16.94	14.85	13.60
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,157,500.46	$1,149,460.07	$1,133,138.43	$1,144,395.69	$1,411,759.91	$1,868,832.74	$1,200,681.99
- Risk Level 1		$1,159,325.44	$1,151,285.04	$1,134,963.41	$1,146,220.67	$1,413,584.88	$1,870,657.72	$1,202,506.97
- Risk Level 2		$1,161,150.33	$1,153,109.93	$1,136,788.30	$1,148,045.56	$1,415,409.77	$1,872,482.61	$1,204,331.86
- Risk Level 3		$1,164,800.20	$1,156,759.80	$1,140,438.16	$1,151,695.42	$1,419,059.64	$1,876,132.47	$1,207,981.72
TOTAL PV INCREMENTAL BENEFITS		$644,515.11	$644,515.11	$644,515.11	$644,515.11	$644,515.11	$644,515.11	$644,515.11
PVB/PVC (INCREMENTAL)								
- Risk Level 0		0.55682	0.56071	0.56879	0.56319	0.45653	0.34488	0.53679
- Risk Level 1		0.55594	0.55982	0.56787	0.56230	0.45594	0.34454	0.53598
- Risk Level 2		0.55507	0.55894	0.56696	0.56140	0.45536	0.34420	0.53516
- Risk Level 3		0.55333	0.55717	0.56515	0.55962	0.45418	0.34353	0.53355

Table C5

AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS
FOR THE NARROWS 49
Population 452

A/C: DHC-6
Temp: 22 C
Elev: 1000 ft
GTOW: 10000 lbs
(non-instrument runway) CAR-3

a)

CIVIL WORKS	PAVEMENT TYPE (P)						
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$247,305.14	$242,893.97	$252,443.41	$256,375.67	$336,752.09	$510,006.44	$276,036.97
Subtotals	$400,942.64	$392,868.97	$420,730.91	$431,988.17	$655,202.09	$1,158,081.44	$488,274.47

(strip length = 426 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 366 m.); gravel= 372 ; turf= 377

Civil works Subtotals:							
1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
3+4+5 :	$269,492.64	$264,218.97	$278,080.91	$283,738.17	$397,752.09	$648,631.44	$312,024.47

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$16,633.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$81,233.00

Grand Totals	$682,175.64	$674,101.97	$701,963.91	$713,221.17	$936,435.09	$1,439,314.44	$769,507.47

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$7,950.84	$8,037.16	$11,796.78	$11,796.78	$7,950.84	$0.00	$11,796.78
	PV	$3,065.37	$3,098.65	$1,656.22	$1,656.22	$3,065.37	$0.00	$1,656.22
f) D $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC	Annual	$285.68	$285.68	$281.46	$281.46	$285.68	$281.46	$281.46
	PV	$2,432.18	$2,432.18	$2,396.24	$2,396.24	$2,432.18	$2,396.24	$2,396.24
h) Incremental Reg. Pass. Serv. DOC (60% LF)	Annual	$5,638.60	$5,638.60	$5,555.27	$5,555.27	$5,638.60	$5,555.27	$5,555.27
	PV	$48,004.78	$48,004.78	$47,295.35	$47,295.35	$48,004.78	$47,295.35	$47,295.35
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$6,022.15	$6,022.15	$6,022.15	$6,022.15	$6,022.15	$6,022.15	$6,022.15
	PV	$51,270.18	$51,270.18	$51,270.18	$51,270.18	$51,270.18	$51,270.18	$51,270.18
Risk Level 1 (1.5X)	Annual	$7,076.02	$7,076.02	$7,076.02	$7,076.02	$7,076.02	$7,076.02	$7,076.02
	PV	$60,242.40	$60,242.40	$60,242.40	$60,242.40	$60,242.40	$60,242.40	$60,242.40
Risk Level 2 (2X)	Annual	$8,129.90	$8,129.90	$8,129.90	$8,129.90	$8,129.90	$8,129.90	$8,129.90
	PV	$69,214.72	$69,214.72	$69,214.72	$69,214.72	$69,214.72	$69,214.72	$69,214.72
Risk Level 3 (3X)	Annual	$10,237.65	$10,237.65	$10,237.65	$10,237.65	$10,237.65	$10,237.65	$10,237.65
	PV	$87,159.26	$87,159.26	$87,159.26	$87,159.26	$87,159.26	$87,159.26	$87,159.26

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 452)								
a) Emergency Health Care								
-lives saved (0.84/yr)	Annual	$198,822.14	$198,822.14	$198,822.14	$198,822.14	$198,822.14	$198,822.14	$198,822.14
	PV	$1,692,692.17	$1,692,692.17	$1,692,692.17	$1,692,692.17	$1,692,692.17	$1,692,692.17	$1,692,692.17
-permanent disabilities	Annual	$77,179.90	$77,179.90	$77,179.90	$77,179.90	$77,179.90	$77,179.90	$77,179.90
prevented (1.68/yr)	PV	$657,078.80	$657,078.80	$657,078.80	$657,078.80	$657,078.80	$657,078.80	$657,078.80
-temp disability-lost	Annual	$365.57	$365.57	$365.57	$365.57	$365.57	$365.57	$365.57
work days saved (26.22/yr)	PV	$3,112.32	$3,112.32	$3,112.32	$3,112.32	$3,112.32	$3,112.32	$3,112.32
b) Air Service User Time	Annual	$54,692.00	$54,692.00	$54,692.00	$54,692.00	$54,692.00	$54,692.00	$54,692.00
Savings (5543 hrs/yr)	PV	$465,625.81	$465,625.81	$465,625.81	$465,625.81	$465,625.81	$465,625.81	$465,625.81

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local		2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Manitoba		2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		4.24	4.16	4.44	4.55	6.91	5.80	5.14
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.38	0.38	0.38	0.38	0.38	0.38	0.38
	-rest of Manitoba		1.61	1.62	1.60	1.60	1.62	1.60	1.60
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.99	2.00	1.98	1.98	2.00	1.98	1.98
SUBTOTAL	-local		3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba		4.49	4.46	4.57	4.63	5.83	5.26	4.93
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		7.60	7.53	7.78	7.90	10.28	9.14	8.49

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.82	1.79	1.91	1.97	2.98	2.51	2.22
	-rest of Canada	1.91	1.87	2.00	2.06	3.12	2.63	2.32
	-total	3.73	3.66	3.92	4.02	6.10	5.14	4.55
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.24	2.21	2.33	2.38	3.40	2.93	2.64
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	4.30	4.22	4.48	4.59	6.66	5.71	5.11
TOTAL SHORT TERM	-local	3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba	6.73	6.66	6.91	7.02	9.23	8.19	7.57
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	11.90	11.75	12.26	12.48	16.94	14.85	13.60
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,237,062.97	$1,229,022.58	$1,212,128.72	$1,223,385.98	$1,491,322.42	$1,947,823.03	$1,279,672.28
- Risk Level 1		$1,246,035.20	$1,237,994.81	$1,221,100.95	$1,232,358.21	$1,500,294.64	$1,956,795.26	$1,288,644.51
- Risk Level 2		$1,255,007.51	$1,246,967.12	$1,230,073.26	$1,241,330.52	$1,509,266.96	$1,965,767.57	$1,297,616.82
- Risk Level 3		$1,272,952.06	$1,264,911.66	$1,248,017.80	$1,259,275.06	$1,527,211.50	$1,983,712.11	$1,315,561.36
TOTAL PV INCREMENTAL BENEFITS		$2,818,509.10	$2,818,509.10	$2,818,509.10	$2,818,509.10	$2,818,509.10	$2,818,509.10	$2,818,509.10
PVB/PVC (INCREMENTAL)								
- Risk Level 0		2.27839	2.29329	2.32526	2.30386	1.88994	1.44700	2.20252
- Risk Level 1		2.26198	2.27667	2.30817	2.28709	1.87864	1.44037	2.18719
- Risk Level 2		2.24581	2.26029	2.29133	2.27055	1.86747	1.43380	2.17207
- Risk Level 3		2.21415	2.22823	2.25839	2.23820	1.84553	1.42083	2.14244

Table C10

AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS
FOR WABOWDEN
Population 650

A/C: DHC-6
Temp: 22 C
Elev: 1000 ft
GTOW: 10000 lbs
(non-instrument runway) CAR-3

a)

CIVIL WORKS		PAVEMENT TYPE (P)						
		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.		$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)		$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)		$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)		$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)		$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)		$247,305.14	$242,893.97	$252,443.41	$256,375.67	$336,752.09	$510,006.44	$276,036.97
	Subtotals	$400,942.64	$392,868.97	$420,730.91	$431,988.17	$655,202.09	$1,158,081.44	$488,274.47
(strip length = 426 m.)								
(graded area width = 38 m.)								
(runway pavement width = 15.2 m. max to 7.6 m. min)								
(runway pavement length = 366 m.)	gravel= 372		turf= 377					
Civil works Subtotals:	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$269,492.64	$264,218.97	$278,080.91	$283,738.17	$397,752.09	$648,631.44	$312,024.47

b) AIR TERMINAL BUILDING AND
RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$16,633.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$81,233.00

Grand Totals	$682,175.64	$674,101.97	$701,963.91	$713,221.17	$936,435.09	$1,439,314.44	$769,507.47

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$7,950.84	$8,037.16	$11,796.78	$11,796.78	$7,950.84	$0.00	$11,796.78
	PV	$3,065.37	$3,098.65	$1,656.22	$1,656.22	$3,065.37	$0.00	$1,656.22
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Increamental A/C Emerg. Serv. DOC	Annual	$163.87	$163.87	$161.45	$161.45	$163.87	$161.45	$161.45
	PV	$1,395.14	$1,395.14	$1,374.52	$1,374.52	$1,395.14	$1,374.52	$1,374.52
h) Increamental Reg. Pass. Serv. DOC (60% LF)	Annual	$8,108.61	$8,108.61	$7,988.78	$7,988.78	$8,108.61	$7,988.78	$7,988.78
	PV	$69,033.48	$69,033.48	$68,013.28	$68,013.28	$69,033.48	$68,013.28	$68,013.28
i) Increamental A/C Accident Costs								
Risk Level 0	Annual	$7,798.32	$7,798.32	$7,798.32	$7,798.32	$7,798.32	$7,798.32	$7,798.32
	PV	$66,391.78	$66,391.78	$66,391.78	$66,391.78	$66,391.78	$66,391.78	$66,391.78
Risk Level 1 (1.5X)	Annual	$9,163.02	$9,163.02	$9,163.02	$9,163.02	$9,163.02	$9,163.02	$9,163.02
	PV	$78,010.29	$78,010.29	$78,010.29	$78,010.29	$78,010.29	$78,010.29	$78,010.29
Risk Level 2 (2X)	Annual	$10,527.73	$10,527.73	$10,527.73	$10,527.73	$10,527.73	$10,527.73	$10,527.73
	PV	$89,628.88	$89,628.88	$89,628.88	$89,628.88	$89,628.88	$89,628.88	$89,628.88
Risk Level 3 (3X)	Annual	$13,257.14	$13,257.14	$13,257.14	$13,257.14	$13,257.14	$13,257.14	$13,257.14
	PV	$112,865.99	$112,865.99	$112,865.99	$112,865.99	$112,865.99	$112,865.99	$112,865.99

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 650)								
a) Emergency Health Care								
-lives saved (1.21/yr)	Annual	$285,916.80	$285,916.80	$285,916.80	$285,916.80	$285,916.80	$285,916.80	$285,916.80
	PV	$2,434,181.27	$2,434,181.27	$2,434,181.27	$2,434,181.27	$2,434,181.27	$2,434,181.27	$2,434,181.27
-permanent disabilities	Annual	$110,988.80	$110,988.80	$110,988.80	$110,988.80	$110,988.80	$110,988.80	$110,988.80
prevented (2.41/yr)	PV	$944,914.25	$944,914.25	$944,914.25	$944,914.25	$944,914.25	$944,914.25	$944,914.25
-temp disability-lost	Annual	$525.71	$525.71	$525.71	$525.71	$525.71	$525.71	$525.71
work days saved (37.7/yr)	PV	$4,475.68	$4,475.68	$4,475.68	$4,475.68	$4,475.68	$4,475.68	$4,475.68
b) Air Service User Time	Annual	$74,182.66	$74,182.66	$74,182.66	$74,182.66	$74,182.66	$74,182.66	$74,182.66
Savings (7519 hrs/yr)	PV	$631,561.49	$631,561.49	$631,561.49	$631,561.49	$631,561.49	$631,561.49	$631,561.49

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local	2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Manitoba	2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	4.24	4.16	4.44	4.55	6.91	5.80	5.14
ATB	-local	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local	0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba	0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local	0.38	0.38	0.38	0.38	0.38	0.38	0.38
	-rest of Manitoba	1.61	1.62	1.60	1.60	1.62	1.60	1.60
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.99	2.00	1.98	1.98	2.00	1.98	1.98
SUBTOTAL	-local	3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba	4.49	4.46	4.57	4.63	5.83	5.26	4.93
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	7.60	7.53	7.78	7.90	10.28	9.14	8.49

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.82	1.79	1.91	1.97	2.98	2.51	2.22
	-rest of Canada	1.91	1.87	2.00	2.06	3.12	2.63	2.32
	-total	3.73	3.66	3.92	4.02	6.10	5.14	4.55
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.24	2.21	2.33	2.38	3.40	2.93	2.64
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	4.30	4.22	4.48	4.59	6.66	5.71	5.11
TOTAL SHORT TERM	-local	3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba	6.73	6.66	6.91	7.02	9.23	8.19	7.57
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	11.90	11.75	12.26	12.48	16.94	14.85	13.60
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,272,176.23	$1,264,135.84	$1,246,946.53	$1,258,203.79	$1,526,435.67	$1,982,640.85	$1,314,490.09
- Risk Level 1		$1,283,794.74	$1,275,754.35	$1,258,565.04	$1,269,822.30	$1,538,054.18	$1,994,259.36	$1,326,108.60
- Risk Level 2		$1,295,413.34	$1,287,372.94	$1,270,183.64	$1,281,440.90	$1,549,672.78	$2,005,877.95	$1,337,727.20
- Risk Level 3		$1,318,650.44	$1,310,610.05	$1,293,420.74	$1,304,678.00	$1,572,909.88	$2,029,115.06	$1,360,964.30
TOTAL PV INCREMENTAL BENEFITS		$4,015,132.69	$4,015,132.69	$4,015,132.69	$4,015,132.69	$4,015,132.69	$4,015,132.69	$4,015,132.69
PVB/PVC (INCREMENTAL)								
- Risk Level 0		3.15611	3.17619	3.21997	3.19116	2.63040	2.02514	3.05452
- Risk Level 1		3.12755	3.14726	3.19025	3.16196	2.61053	2.01335	3.02776
- Risk Level 2		3.09950	3.11886	3.16106	3.13330	2.59096	2.00168	3.00146
- Risk Level 3		3.04488	3.06356	3.10427	3.07749	2.55268	1.97876	2.95021

Table C11

AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS
FOR TADOULE LAKE
Population 250

A/C: DHC-6
Temp: 22 C
Elev: 1000 ft
GTOW: 10000 lbs
(non-instrument runway) CAR-3

a)

CIVIL WORKS	PAVEMENT TYPE (P)						
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$247,305.14	$242,893.97	$252,443.41	$256,375.67	$336,752.09	$510,006.44	$276,036.97
Subtotals	$400,942.64	$392,868.97	$420,730.91	$431,988.17	$655,202.09	$1,158,081.44	$488,274.47

(strip length = 426 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 366 m.); gravel= 372 ; turf= 377

Civil works Subtotals:	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$269,492.64	$264,218.97	$278,080.91	$283,738.17	$397,752.09	$648,631.44	$312,024.47

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$16,633.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$81,233.00

Grand Totals	$682,175.64	$674,101.97	$701,963.91	$713,221.17	$936,435.09	$1,439,314.44	$769,507.47

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$7,950.84	$8,037.16	$11,796.78	$11,796.78	$7,950.84	$0.00	$11,796.78
	PV	$3,065.37	$3,098.65	$1,656.22	$1,656.22	$3,065.37	$0.00	$1,656.22
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC	Annual	$160.90	$160.90	$158.52	$158.52	$160.90	$158.52	$158.52
	PV	$1,369.82	$1,369.82	$1,349.58	$1,349.58	$1,369.82	$1,349.58	$1,349.58
h) Incremental Reg. Pass. Serv. DOC (60% LF)	Annual	$3,118.70	$3,118.70	$3,072.61	$3,072.61	$3,118.70	$3,072.61	$3,072.61
	PV	$26,551.36	$26,551.36	$26,158.97	$26,158.97	$26,551.36	$26,158.97	$26,158.97
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$4,210.10	$4,210.10	$4,210.10	$4,210.10	$4,210.10	$4,210.10	$4,210.10
	PV	$35,843.11	$35,843.11	$35,843.11	$35,843.11	$35,843.11	$35,843.11	$35,843.11
Risk Level 1 (1.5X)	Annual	$4,946.87	$4,946.87	$4,946.87	$4,946.87	$4,946.87	$4,946.87	$4,946.87
	PV	$42,115.67	$42,115.67	$42,115.67	$42,115.67	$42,115.67	$42,115.67	$42,115.67
Risk Level 2 (2X)	Annual	$5,683.63	$5,683.63	$5,683.63	$5,683.63	$5,683.63	$5,683.63	$5,683.63
	PV	$48,388.15	$48,388.15	$48,388.15	$48,388.15	$48,388.15	$48,388.15	$48,388.15
Risk Level 3 (3X)	Annual	$7,157.17	$7,157.17	$7,157.17	$7,157.17	$7,157.17	$7,157.17	$7,157.17
	PV	$60,933.28	$60,933.28	$60,933.28	$60,933.28	$60,933.28	$60,933.28	$60,933.28

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 250)								
a) Emergency Health Care								
-lives saved (0.46/yr)	Annual	$109,968.00	$109,968.00	$109,968.00	$109,968.00	$109,968.00	$109,968.00	$109,968.00
	PV	$936,223.56	$936,223.56	$936,223.56	$936,223.56	$936,223.56	$936,223.56	$936,223.56
-permanent disabilities	Annual	$42,688.00	$42,688.00	$42,688.00	$42,688.00	$42,688.00	$42,688.00	$42,688.00
prevented (0.93/yr)	PV	$363,428.56	$363,428.56	$363,428.56	$363,428.56	$363,428.56	$363,428.56	$363,428.56
-temp disability-lost	Annual	$202.20	$202.20	$202.20	$202.20	$202.20	$202.20	$202.20
work days saved (14.5/yr)	PV	$1,721.45	$1,721.45	$1,721.45	$1,721.45	$1,721.45	$1,721.45	$1,721.45
b) Air Service User Time	Annual	$34,807.60	$34,807.60	$34,807.60	$34,807.60	$34,807.60	$34,807.60	$34,807.60
Savings (3528 hrs/yr)	PV	$296,337.98	$296,337.98	$296,337.98	$296,337.98	$296,337.98	$296,337.98	$296,337.98

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local		2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Manitoba		2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		4.24	4.16	4.44	4.55	6.91	5.80	5.14
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.38	0.38	0.38	0.38	0.38	0.38	0.38
	-rest of Manitoba		1.61	1.62	1.60	1.60	1.62	1.60	1.60
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.99	2.00	1.98	1.98	2.00	1.98	1.98
SUBTOTAL	-local		3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba		4.49	4.46	4.57	4.63	5.83	5.26	4.93
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		7.60	7.53	7.78	7.90	10.28	9.14	8.49

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.82	1.79	1.91	1.97	2.98	2.51	2.22
	-rest of Canada	1.91	1.87	2.00	2.06	3.12	2.63	2.32
	-total	3.73	3.66	3.92	4.02	6.10	5.14	4.55
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.24	2.21	2.33	2.38	3.40	2.93	2.64
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	4.30	4.22	4.48	4.59	6.66	5.71	5.11
TOTAL SHORT TERM	-local	3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba	6.73	6.66	6.91	7.02	9.23	8.19	7.57
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	11.90	11.75	12.26	12.48	16.94	14.85	13.60
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,199,120.12	$1,191,079.73	$1,174,518.61	$1,185,775.87	$1,453,379.57	$1,910,212.93	$1,242,062.17
- Risk Level 1		$1,205,392.69	$1,197,352.29	$1,180,791.18	$1,192,048.44	$1,459,652.13	$1,916,485.49	$1,248,334.74
- Risk Level 2		$1,211,665.17	$1,203,624.77	$1,187,063.66	$1,198,320.92	$1,465,924.61	$1,922,757.97	$1,254,607.22
- Risk Level 3		$1,224,210.30	$1,216,169.90	$1,199,608.79	$1,210,866.05	$1,478,469.74	$1,935,303.10	$1,267,152.35
TOTAL PV INCREMENTAL BENEFITS		$1,597,711.55	$1,597,711.55	$1,597,711.55	$1,597,711.55	$1,597,711.55	$1,597,711.55	$1,597,711.55
PVB/PVC (INCREMENTAL)								
- Risk Level 0		1.33240	1.34140	1.36031	1.34740	1.09931	0.83640	1.28634
- Risk Level 1		1.32547	1.33437	1.35309	1.34031	1.09458	0.83367	1.27987
- Risk Level 2		1.31861	1.32742	1.34594	1.33329	1.08990	0.83095	1.27348
- Risk Level 3		1.30510	1.31372	1.33186	1.31948	1.08065	0.82556	1.26087

Table C12

AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS
FOR SHERRIDON
Population 167

A/C: DHC-6
Temp: 22 C
Elev: 1000 ft
GTOW: 10000 lbs
(non-instrument runway) CAR-3

a)

CIVIL WORKS	PAVEMENT TYPE (P)						
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$247,305.14	$242,893.97	$252,443.41	$256,375.67	$336,752.09	$510,006.44	$276,036.97
Subtotals	$400,942.64	$392,868.97	$420,730.91	$431,988.17	$655,202.09	$1,158,081.44	$488,274.47

(strip length = 426 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 366 m.); gravel= 372 ; turf= 377

Civil works Subtotals:	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$269,492.64	$264,218.97	$278,080.91	$283,738.17	$397,752.09	$648,631.44	$312,024.47

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipaent	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachaents	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$16,633.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$81,233.00

	Grand Totals	$682,175.64	$674,101.97	$701,963.91	$713,221.17	$936,435.09	$1,439,314.44	$769,507.47

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$7,950.84	$8,037.16	$11,796.78	$11,796.78	$7,950.84	$0.00	$11,796.78
	PV	$3,065.37	$3,098.65	$1,656.22	$1,656.22	$3,065.37	$0.00	$1,656.22
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Increamental A/C Energ. Serv. DOC	Annual	$107.47	$107.47	$105.88	$105.88	$107.47	$105.88	$105.88
	PV	$914.94	$914.94	$901.42	$901.42	$914.94	$901.42	$901.42
h) Increamental Reg. Pass. Serv. DOC (60% LF)	Annual	$2,083.29	$2,083.29	$2,052.50	$2,052.50	$2,083.29	$2,052.50	$2,052.50
	PV	$17,736.28	$17,736.28	$17,474.16	$17,474.16	$17,736.28	$17,474.16	$17,474.16
i) Increamental A/C Accident Costs								
Risk Level 0	Annual	$3,465.54	$3,465.54	$3,465.54	$3,465.54	$3,465.54	$3,465.54	$3,465.54
	PV	$29,504.22	$29,504.22	$29,504.22	$29,504.22	$29,504.22	$29,504.22	$29,504.22
Risk Level 1 (1.5X)	Annual	$4,072.01	$4,072.01	$4,072.01	$4,072.01	$4,072.01	$4,072.01	$4,072.01
	PV	$34,667.46	$34,667.46	$34,667.46	$34,667.46	$34,667.46	$34,667.46	$34,667.46
Risk Level 2 (2X)	Annual	$4,678.48	$4,678.48	$4,678.48	$4,678.48	$4,678.48	$4,678.48	$4,678.48
	PV	$39,830.71	$39,830.71	$39,830.71	$39,830.71	$39,830.71	$39,830.71	$39,830.71
Risk Level 3 (3X)	Annual	$5,891.42	$5,891.42	$5,891.42	$5,891.42	$5,891.42	$5,891.42	$5,891.42
	PV	$50,157.19	$50,157.19	$50,157.19	$50,157.19	$50,157.19	$50,157.19	$50,157.19

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 167)								
a) Emergency Health Care								
-lives saved (0.31/yr)	Annual	$73,458.00	$73,458.00	$73,458.00	$73,458.00	$73,458.00	$73,458.00	$73,458.00
	PV	$625,392.03	$625,392.03	$625,392.03	$625,392.03	$625,392.03	$625,392.03	$625,392.03
-permanent disabilities	Annual	$28,515.58	$28,515.58	$28,515.58	$28,515.58	$28,515.58	$28,515.58	$28,515.58
prevented (0.61/yr)	PV	$242,770.24	$242,770.24	$242,770.24	$242,770.24	$242,770.24	$242,770.24	$242,770.24
-temp disability-lost	Annual	$135.07	$135.07	$135.07	$135.07	$135.07	$135.07	$135.07
work days saved (9.7/yr)	PV	$1,149.93	$1,149.93	$1,149.93	$1,149.93	$1,149.93	$1,149.93	$1,149.93
b) Air Service User Time	Annual	$26,637.27	$26,637.27	$26,637.27	$26,637.27	$26,637.27	$26,637.27	$26,637.27
Savings (2700 hrs/yr)	PV	$226,779.06	$226,779.06	$226,779.06	$226,779.06	$226,779.06	$226,779.06	$226,779.06

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local	2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Manitoba	2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	4.24	4.16	4.44	4.55	6.91	5.80	5.14
ATB	-local	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local	0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba	0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local	0.38	0.38	0.38	0.38	0.38	0.38	0.38
	-rest of Manitoba	1.61	1.62	1.60	1.60	1.62	1.60	1.60
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.99	2.00	1.98	1.98	2.00	1.98	1.98
SUBTOTAL	-local	3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba	4.49	4.46	4.57	4.63	5.83	5.26	4.93
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	7.60	7.53	7.78	7.90	10.28	9.14	8.49

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.82	1.79	1.91	1.97	2.98	2.51	2.22
	-rest of Canada	1.91	1.87	2.00	2.06	3.12	2.63	2.32
	-total	3.73	3.66	3.92	4.02	6.10	5.14	4.55
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.24	2.21	2.33	2.38	3.40	2.93	2.64
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	4.30	4.22	4.48	4.59	6.66	5.71	5.11
TOTAL SHORT TERM	-local	3.11	3.07	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba	6.73	6.66	6.91	7.02	9.23	8.19	7.57
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	11.90	11.75	12.26	12.48	16.94	14.85	13.60
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,183,511.28	$1,175,470.88	$1,159,046.76	$1,170,304.02	$1,437,770.72	$1,894,741.08	$1,226,590.32
- Risk Level 1		$1,188,674.52	$1,180,634.13	$1,164,210.01	$1,175,467.27	$1,442,933.96	$1,899,904.32	$1,231,753.57
- Risk Level 2		$1,193,837.76	$1,185,797.37	$1,169,373.25	$1,180,630.51	$1,448,097.21	$1,905,067.56	$1,236,916.81
- Risk Level 3		$1,204,164.25	$1,196,123.86	$1,179,699.74	$1,190,957.00	$1,458,423.69	$1,915,394.05	$1,247,243.30
TOTAL PV INCREMENTAL BENEFITS		$1,096,091.26	$1,096,091.26	$1,096,091.26	$1,096,091.26	$1,096,091.26	$1,096,091.26	$1,096,091.26
PVB/PVC (INCREMENTAL)								
- Risk Level 0		0.92614	0.93247	0.94568	0.93659	0.76235	0.57849	0.89361
- Risk Level 1		0.92211	0.92839	0.94149	0.93247	0.75963	0.57692	0.88986
- Risk Level 2		0.91812	0.92435	0.93733	0.92839	0.75692	0.57536	0.88615
- Risk Level 3		0.91025	0.91637	0.92913	0.92034	0.75156	0.57225	0.87881

APPENDIX D

Manitoba Implementation

Cost Schedule

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
SITE # 1					
-construction costs	$542,175				
-equipment purchase (vehicles)	$140,000				
-O&M		$45,000	$45,000	$45,000	$45,000
-resurfacing					
-equipment replacement (vehicles)					
SITE # 2					
-construction costs		$542,175			
-equipment purchase (vehicles)		$140,000			
-O&M			$45,000	$45,000	$45,000
-resurfacing					
-equipment replacement (vehicles)					
SITE # 3					
-construction costs			$542,175		
-equipment purchase (vehicles)			$140,000		
-O&M				$45,000	$45,000
-resurfacing					
-equipment replacement (vehicles)					
SITE # 4					
-construction costs				$542,175	
-equipment purchase (vehicles)				$140,000	
-O&M					$45,000
-resurfacing					
-equipment replacement (vehicles)					
SITE # 5					
-construction costs					$542,175
-equipment purchase (vehicles)					$140,000
-O&M					
-resurfacing					
-equipment replacement (vehicles)					
SITE # 6					
-construction costs					$542,175
-equipment purchase (vehicles)					$140,000
-O&M					
-resurfacing					
-equipment replacement (vehicles)					
SITE # 7					
-construction costs					
-equipment purchase (vehicles)					
-O&M					
-resurfacing					
-equipment replacement (vehicles)					
SITE # 8					
-construction costs					
-equipment purchase (vehicles)					
-O&M					
-resurfacing					
-equipment replacement (vehicles)					
SITE # 9					
-construction costs					
-equipment purchase (vehicles)					
-O&M					
-resurfacing					
-equipment replacement (vehicles)					
SITE # 10					
-construction costs					
-equipment purchase (vehicles)					
-O&M					
-resurfacing					
-equipment replacement (vehicles)					
SITE # 11					
-construction costs					
-equipment purchase (vehicles)					
-O&M					
-resurfacing					
-equipment replacement (vehicles)					
SITE # 12					
-construction costs					
-equipment purchase (vehicles)					
-O&M					
-resurfacing					
-equipment replacement (vehicles)					
YEARLY TOTALS					
-construction costs	$542,175	$542,175	$542,175	$542,175	$1,084,350
-equipment purchase (vehicles)	$140,000	$140,000	$140,000	$140,000	$280,000
-O&M	$0	$45,000	$90,000	$135,000	$180,000
-resurfacing	$0	$0	$0	$0	$0
-equipment replacement (vehicles)	$0	$0	$0	$0	$0
TOTAL COSTS	$682,175	$727,175	$772,175	$817,175	$1,544,350

Constant dollar costs of constructing, operating & maintaining 12 airports over a 20 year period

MANITOBA IMPLEMENTATION COST SCHEDULE

YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12
$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000
				$15,000				$7,950	$140,000	
$542,175										
$140,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000
					$15,000				$7,950	
	$542,175									$140,000
	$140,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000
						$15,000				$7,950
		$542,175								
		$140,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000
							$15,000			
			$542,175							
			$140,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000
								$15,000		
			$542,175							
			$140,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000
								$15,000		
				$542,175						
				$140,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000
									$15,000	
					$542,175					
					$140,000	$45,000	$45,000	$45,000	$45,000	$45,000
										$15,000
						$542,175				
						$140,000	$45,000	$45,000	$45,000	$45,000
							$542,175			
							$140,000	$45,000	$45,000	$45,000
								$542,175		
								$140,000	$45,000	$45,000
									$542,175	
									$140,000	$45,000
$542,175	$542,175	$542,175	$1,084,350	$542,175	$542,175	$542,175	$542,175	$1,084,350	$0	$0
$140,000	$140,000	$140,000	$280,000	$140,000	$140,000	$140,000	$140,000	$280,000	$0	$0
$45,000	$90,000	$135,000	$180,000	$270,000	$315,000	$360,000	$405,000	$450,000	$540,000	$540,000
$0	$0	$0	$0	$0	$0	$0	$0	$7,950	$7,950	$7,950
$0	$0	$0	$0	$15,000	$15,000	$15,000	$15,000	$30,000	$155,000	$155,000
$727,175	$772,175	$817,175	$1,544,350	$967,175	$1,012,175	$1,057,175	$1,102,175	$1,852,300	$702,950	$702,950

r costs of constructing, operating &
2 airports over a 20 year period

OULE

YEAR 13	YEAR 14	YEAR 15	YEAR 16	YEAR 17	YEAR 18	YEAR 19	YEAR 20	YEAR 21	TOTALS
									======
$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$542,175
			$15,000				$7,950	$140,000	$140,000
									$900,000
									$15,900
									$310,000
$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$542,175
				$15,000				$7,950	$140,000
									$855,000
									$15,900
									$170,000
$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$542,175
$140,000					$15,000				$140,000
									$810,000
									$7,950
									$170,000
$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$542,175
$7,950	$140,000					$15,000			$140,000
									$765,000
									$7,950
									$170,000
$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$542,175
	$7,950	$140,000					$15,000		$140,000
									$720,000
									$7,950
									$170,000
$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$542,175
	$7,950	$140,000					$15,000		$140,000
									$720,000
									$7,950
									$170,000
$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$542,175
		$7,950	$140,000					$15,000	$140,000
									$675,000
									$7,950
									$170,000
$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$542,175
			$7,950	$140,000					$140,000
									$630,000
									$7,950
									$155,000
$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$542,175
$15,000				$7,950	$140,000				$140,000
									$585,000
									$7,950
									$155,000
$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$542,175
	$15,000				$7,950	$140,000			$140,000
									$540,000
									$7,950
									$155,000
$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$542,175
		$15,000				$7,950	$140,000		$140,000
									$495,000
									$7,950
									$155,000
$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$542,175
		$15,000				$7,950	$140,000		$140,000
									$495,000
									$7,950
									$155,000
$0	$0	$0	$0	$0	$0	$0	$0	$0	$6,306,100
$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,680,000
$540,000	$540,000	$540,000	$540,000	$540,000	$540,000	$540,000	$540,000	$340,000	$8,190,000
$7,950	$15,900	$7,950	$7,950	$7,950	$7,950	$15,900	$7,950	$7,950	$111,300
$155,000	$155,000	$310,000	$155,000	$155,000	$155,000	$155,000	$310,000	$155,000	$2,105,000
$702,950	$710,900	$857,950	$702,950	$702,950	$702,950	$710,900	$857,950	$702,950	$18,592,400